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# Including All

## A Study on the Measurement of Inflation

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# Abstract

The thesis concerns inflation measuring and investigates how an alternative to the CPI or GDP-deflator inflation measures could be constructed. The theoretical foundations are based on the quantity theory of money. The measure is constructed as a weighted index where the weights are determined through a statistical method that assigns a weight to a good or a group of goods according to its volatility, where a high volatility renders a low weight, since stability is considered to be one of the main features of a inflation measure. The index is then compared to the CPI and the GDP-deflator to see what differences the indices show regarding perceived inflation. All three indices are then put into a Taylor equation to test if a broader inflation measure would've signalled a different monetary policy than the two regular inflation measures. The results were inconclusive, neither supporting nor discarding the broader measurement of inflation. The short conclusion that can be made is that the subject requires more research, especially within the field of statistics and weighting, since one of the biggest problems under the scientific process was the data coverage.

Keywords: inflation, inflation measuring, monetary policy, Taylor rule, asset prices

# Table of Contents

# 1. Introduction

Inflation derives from the Latin word *infla'tio*, which in turn stems from the verb *i'nflo* meaning to blow up (Nationalencyclopedin 1). The term was first used to describe inflation in the supply of money, that is, an increase of the money stock (Bernholz 2003:1). However, the term later got to describe the increase in the general price level, which is the definition that is still widely used.

What should be seen as the general price level is a debated question, but without entering into a deep-going theoretical discussions about this, yet, one could state that it is the amount of nominal currency that is required to purchase a certain set of goods and services, that is regarded to describe the "general level". If we have to pay more for this certain set of goods and services in the second period than in the first the general price level has risen and we are experiencing inflation (Fregert 2007:7, 12-13).

Having stated that inflation is an increase in the general price level a number of theoretically-based questions appear. What creates inflation? What is the general price level and what goods and services should be included in the measure?

The thoughts and experiences regarding inflation aren't new, supposedly dating back to the undertaking of using money as a means to pay for something, which is roughly about 2500 years ago. For Europe the inflow of gold from the Spanish conquests in Latin America during the 16$^{th}$ century increased the amount of gold in circulation leading to a reduction in the value of gold bringing about the need to pay with more gold to uphold the same consumption as before the supply increased. Since gold was that time's money as a generable acceptable good to pay with, what they really experienced was an increase in the money supply (Bernholz 2003:1-2). From that on, if not sooner, people started to more thoroughly investigate the effects of an increase in the money supply and this led up to the formation, or beginning, of the *quantity theory of money* by David Hume in 1752 (Fregert 2007:11 & Hume 1752).

The quantity theory of money was later re-stated in a more formal way by Irving Fisher. Fisher elucidated the theory by showing how an increase in prices stemmed from an increase in either the quantity of money (money supply) or the velocity of money, which is the number of times a unit of money is used over a certain time period (Fisher 1918: 160-164).

I will account for and discuss the quantity theory of money in a more detailed manner in the theory section of this thesis, but what can be said about it is that there's today a consensus among economists that the quantity theory of money and its implication that inflation, primarily, derives from an increase in the quantity of money holds true in the long run (Fregert 2007:10). What is then of high importance to decide is what constitutes the general level of prices, which is the aim of this thesis.

The most widespread measure for changes in the general price level, inflation, is the consumer price index (CPI). The CPI is an index based on the cost of living and consists of a basket of goods and services that are each given a weight according to some pre-decided characteristic i.e. their share of household consumption. The reasons and methods to establish the weights differ from country to country. A more expensive basket in time period 1 than in time period 0 is declared as inflation, since it then costs more to obtain the same level of utility (Wynne 1999:1). The main problem with the CPI is the fact that it's a cost of living index, which is not the same as the overall price movements in the economy, and could therefore be questioned whether or not it is plausible as an inflation measure from a theoretical point of view. Fisher was clear on the point regarding the construction of a price index in accordance with the quantity theory that the index would have to cover all prices in the economy, more specifically everything that is purchased or purchasable (Fisher 1911:218). Friedman reached the same conclusion when further developing the quantity theory in to what came to be the monetarist stand-point in the counter-revolution against Keynesianism (Friedman & Goodhart 2003:86-87).

A main difference between the CPI and a more inclusive index is the exclusion or inclusion of asset prices. During the second half of the 20$^{th}$ century there has been some significant theoretical and empirical work on this matter. The debate came to life in the 1970's when Armen A. Alchian and Benjamin Klein presented an intertemporal cost of living index (Alchian & Klein 1973), which, apart from the CPI, measured the cost of living over a lifetime and therefore also included asset prices, since assets are purchased and at some time render the individual utility (ibid).

Alchian and Klein built an interesting theoretical case and other researchers picked up the torch and continued to try the theories empirically by constructing different types of indices. See for example (Shibuya 1992, Filardo 1999, Goodhart 2001, Cecchetti et al 2001). One of the strongest cases was put forward by Bryan, Cecchetti and O'Sullivan in 2001 showed through a dynamic factor index that the failure to include asset prices in the measurement of inflation created a downward bias of the overall inflation rate of about a

quarter of a percent. They also pointed out house prices as the most important asset price to be included in the inflation measure (Cecchetti et al 2001). A quite thorough test of the theories of Alchian & Klein was made by Hiroshi Shibya in 1992, where he with the dynamic equilibrium price index (DEPI), that measures a change in ex ante intertemporal cost of living apart from CPI, which is a one-period index, showed that Japan had a higher rate of inflation in 1972-73, 1979-80 and 1986-89 than the CPI or GDP-deflator suggested. Especially the last period was a period of rapid asset price increases (Shibuya 1992). One of the most prominent figures of this type of research today is Charles Goodhart. Goodhart's research suggests that there is a strong link between housing price movements and subsequent output and inflation, and less so when it comes to equity prices (Goodhart 2001). Together with Boris Hoffman Goodhart also showed that excluding asset prices created a bias in the measurement of inflation, leading to the economy being based on a misspecified model regarding inflation measuring. In the same study they also put forward that ignoring asset prices lead to a sub-optimal outcome for the economy (Goodhart & Hoffman 2002). Despite the fact that a lot of the earlier work led to substantial results and in many ways proof of both a linkage between asset price inflation and consumer price inflation as well as it being correct to include asset prices in the inflation measure there has been no concrete change in the way monetary authorities conduct monetary policy with respect to asset prices. The question also seemed to somewhat die out after the turn of the new millennia.

There are, however, good reasons for a continuation in studying asset prices and inflation. We have experienced no less than two crises in the asset markets within the latest decade. The first in the stock market and the second in both the stock market as well as the housing market. A possible explanation, or at least a part of an explanation, for this is that the monetary authorities might have set an interest rate that was sub-optimal for the actual economic situation. A mere focus on consumer prices might have led the central banks to adopt a policy that should have been either tighter or looser if the whole scope of the price movements in the economy should have been analysed. Too tight of a monetary policy in times when it should have been loose, and too loose of a monetary policy in times when it should have been tight could have spurred erroneously economic behaviour and worsened the economic outcome, leading to a situation where the asset markets crashed, and by this, dragged the rest of the economy with them.

What I will aim to do in this thesis is to evaluate how another kind of index would perform in comparison with the CPI and the GDP-deflator. To do this I will first present theoretical reasons for doing so, and thus, on a theoretical level answer the question whether

or not a broader inflation measurement and a broader definition of the general price level in accordance with the quantity theory of money should be adopted. Further, I will test this empirically, and in doing so analyse if this broader measurement and definition would have encouraged the monetary authorities to conduct another kind of monetary policy, that is, would the monetary authorities have acted differently with a broader measurement of inflation?

In chapter 2 I will in a detailed manner account for all the theoretical foundations on which I base my view on inflation and inflation measuring. In chapter 3 I present my methodological approach in dealing with the issue of what weights that should be given to the different components of the inflation measure. I also describe how I intend to test a different policy of the monetary authorities. In chapter 4 I present my results and analyse them, and in chapter 5 I summarise and discuss my findings.

# 2. Theory

Essentially the thesis is about measuring inflation. To be able to do this in a proper way we'll first have to state what inflation is. This chapter, therefore, starts off with a theoretical explanation of inflation and its determinants. Further, I give a theoretical approach on how a price index should be constructed and why a mere measurement of the development of prices for consumption goods may not be sufficient for a proper measurement of inflation. Last, I present the theoretical foundations of the Taylor rule on which I base my fictional central-bank interest-rate setting when investigating my second problem of if the central banks have been setting a faulty interest rate in respect to the more broadly measured inflation rate.

## 2.1 Inflation and Its Determinants

As I stated in the previous chapter, inflation is a rise in the general level of prices. The first crucial part to find out is wherefrom such movements in the price level stem. My theoretical approach in this thesis towards the origins of inflation is the quantity theory of money. Below I present the theory as stated by Fisher and later on Friedman. This I do, since I regard the quantity theory of money to be the theoretical foundation that my analysis rests upon. The same holds true for the theories of Alchian and Klein, which also derive from the quantity theory of money. By leaving out a formal declaration of the theory's contents and reasoning I believe I also would be leaving out a great deal of explanation regarding my basic view upon inflation, therefore the quantity theory of money is here accounted for as my theoretical view on inflation and its origins.

### 2.1.1 The Quantity Theory of Money

In short one can say that the quantity theory of money states that inflation primarily derives from an increase in the quantity of money, the money supply. Observations of the loss in the purchasing power of money when an increase in money supply occurred date back thousands of years (Friedman & Goodhart 2003:66). Hence, the basic reasoning underlying the quantity

theory is in no way new. It was, however, systemised by Irving Fisher around the turn of the 20th century. What Fisher did was to present an equation stating the relationship between the money-side of the economy and the output-side of the economy, the equation of exchange:

$$MV = PT \tag{1}$$

Where $M$ is the quantity of money, $V$ is the velocity of money, $P$ the general price level and $T$ the number of transactions taking place in the economy. By velocity of money Fisher meant the number of times a unit of generally acceptable good for payment was used over a certain period of time. The $T$-variable in turn is the number of transactions during that period of time or, shortly, the volume of trade, which is somewhat of a simplification of the original form of the equation:

$$MV = pQ + p'Q' + ,...,+ p^nQ^n \tag{2}$$

That is,

$$MV = \sum pQ \tag{3}$$

From the above we get that $p$ is the price of a certain good and $Q$ is the number of units of that good that is being purchased. What Fisher did then was derive an average price of all the $p$-values, thus creating the variable for the general price level, $P$. The same was done for the total amount of $Q$-values, which formed the transaction variable, $T$ (Fisher 1918:151-161).

The equation of exchange, or the quantity equation as Friedman called it, is not the same thing as the quantity theory of money (Friedman & Schwartz 1982:19). Though the equation of exchange tells us about the relationship between the two sides of the economy in relation to money, it says little or nothing about wherefrom changes in for example money demand stem. The quantity theory of money in the way Friedman re-stated it utterly deals with the demand for money (Friedman 1956:4). The Keynesian critique of the quantity of money, which I will examine in the next paragraph, implied that inflation stemmed from changes in aggregate demand, and more especially, in the demand for money. The supply and velocity of money thus followed the demand for money, making them of less importance to the overall performance of the economy. What Friedman argued, which made the quantity theory of money valid again, was that the demand for money was stable and changes in it proceeded slowly and gradually with the result that substantial changes in prices or nominal income stemmed from changes in the quantity of money (Friedman & Schwartz 1982:19).

The demand for money can formally be expressed in the same way as the demand for consumption goods. As in consumer choice, the demand for money depends on three major aspects: (i) the total wealth to be held, that is, the budget constraint, (ii) the price of and the

return on this form of wealth and alternative forms, (iii) the tastes and preferences of the wealth-owning units, that is, individuals, companies etc. (Friedman 1956:4). Further, wealth is considered as all sources of income or consumable services. Wealth is expressed as:

$$W = \frac{Y}{r} \tag{4}$$

where $Y$ is the total flow of income and $r$ the interest rate. Wealth can then, in turn, be held in various forms. The relationship between the different forms is \$1.00 worth for \$1.00 worth and the various forms brought down to five main ones in which wealth can be held are: (i) money (M); (ii) bonds (B); (iii) equities (E); (iv) physical non-human goods (G); and human capital (H) (Friedman 1956:4-5).

Each form then has a certain yield, where the yield for money depends on the volume of goods that one unit of money will get the individual. With other words this can be described as the price level, $P$ (Friedman 1956:5-6).

Bonds, in turn, are viewed upon as an on-going income stream of a constant amount, which yields an annual sum, the coupon rate, or any change in the price of the bond over time. The market rate for a bond is $r_b$ (which is also the coupon rate and yield would there be no price changes) and the nominal income stream for \$1.00 at time zero and approximated by its value at time zero is then:

$$r_b - \frac{1}{r_b}\frac{dr_b}{dt} \tag{5}$$

where $t$ stands for time. The above together with $P$ gives the real return from holding \$1.00 of wealth in bonds (Friedman 1956:6).

When it comes to equities the nominal return to a holder of the equity takes three forms: the constant nominal amount received per year if there's no change in $P$; the increase or decrease in this amount if there's a change in $P$; and any price change of the equity itself. The market rate for equities is defined as $r_e$, where $1/r_e$ is the price of an equity that will pay \$1.00 a year if the price level doesn't change. The same reasoning applies to bonds and the bond market rate, $r_b$. The nominal stream purchased at time zero and approximated by its value at tie zero is then:

$$r_e + \frac{1}{P}\frac{dP}{dt} - \frac{1}{r_e}\frac{dr_e}{dt} \tag{6}$$

the above together with $P$ gives the real return from holding \$1.00 of wealth in equities (Friedman 1956:6-7).

Physical goods don't yield any money, instead they yield utility and are thus connected with the purchasing power of money. If the price level, *P*, applies equally to all goods the value of these goods at time zero will be:

$$\frac{1}{P}\frac{dP}{dT} \tag{7}$$

Together with *P* this gives the real return from holding $1.00 of wealth in physical goods (Friedman 1956:8).

The last form, human capital, is considered in a different way than we usually consider human capital. By this we don't mean human capital in the sense of education, but rather in the sense of owning humans. Luckily, the slave market in modern economies today is non-existent so we have to apply another view of looking upon human capital. Instead of owning a human being and its work capacity, one can enter a contract with another person rendering personal services for a specific amount of payment, which could be seen as semi-owning the person for a certain period of time. Considering these human services as the human-wealth part of the total wealth we can construct a ratio between non-human and human wealth, *w*, which will be the variable regarding human capital (Friedman 1956:9).

Taking the yields of these various forms of wealth holding and combining them we end up with the following demand function for money:

$$M = f(P, r_b - \frac{1}{r_b}\frac{dr_b}{dt}, r_e + \frac{1}{P}\frac{dP}{dt} - \frac{1}{r_e}\frac{dr_e}{dt}, \frac{1}{P}\frac{dP}{dt}; w; \frac{Y}{r}; u) \tag{8}$$

where *u* describes any variable affecting tastes and preferences. Here it's important to underline that when dealing with maximisation of demand analyses where the variables are of a "real" nature, the equation must be independent from the nominal values in which the variables are measured. That is, if the unit in which prices and money income is changed the demanded amount of money should change proportionally. This implies that equation (9) is to be regarded as homogenous of the first degree in *P* and *Y*, which gives:

$$f(\lambda P, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; \lambda Y; u) = \lambda f(P, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; Y; u) \tag{9}$$

If we then let $\lambda = 1/Y$, we get:

$$\frac{M}{Y} = f(r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w, \frac{P}{Y}, u) = \frac{1}{v(r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w, \frac{Y}{P}, u)} \tag{10}$$

or

$$Y = v(r_b, r_e, \frac{1}{P}\frac{dP}{dt}, w, \frac{Y}{P}, u) * M \quad (11)$$

where *v* is income velocity and the equation now has taken a resembling form of the equation of exchange (Friedman 1956:10-11).

### 2.1.2 Critique

Up to about 1930, when the theories of John Maynard Keynes started to gain widespread support, the quantity theory of money and the equation of exchange were considered as the corner stones of monetary theory. The velocity variable was regarded as highly stable, thus leading to the conclusion that an increase in the quantity of money would either raise prices or output (or both) (Friedman & Goodhart 2003:68).

What came to show was that velocity necessarily wasn't stable, which in turn makes the demand for money erratic, and one of Keynes' major criticisms of the quantity theory was that there seemed to be no systematic behaviour of the velocity of money (Friedman & Schwartz 1982:42). Au contraire, it seemed to either plunge when the money supply increased or go up when the money supply decreased (Friedman & Goodhart 2003:71). The velocity variable was later, together with the rest of the quantity theory, scrutinised by Milton Friedman and Anna Schwarz. They discovered that the velocity of money in no respect was a will-o'-the-wisp, as Keynes had named it. It, first of all, usually moved in the same direction as the increase in the quantity of money and nominal income. Secondly, a velocity variable written as a numerical constant based on the average value of the empirical observations of the variable during their period of analysis (1867-1975) covered 94.5 percent of the variability in money. The conclusion; that velocity might not be extremely rigid holds true, but at the same time it isn't especially volatile either, and a constant value for the variable can account for much of its effect within the quantity theory of money (Friedman & Schwarz 1982: 207-213).

Another major criticism that Keynes put forward against the quantity theory of money was that it didn't take into account the demand for money[1]. Keynes generally seeking for explanations in the demand-side of the economy claimed that what mattered was the part of total spending that is independent from current income, the autonomous spending. This together with the view upon velocity as highly unstable led to the conclusion that the quantity

[1] Please note that the works of Friedman, from which I've taken most of my theoretic reasoning regarding money demand, were published after the Keynesian critique.

of money didn't matter to the extent that quantity theorists meant it did (Friedman & Goodhart 2003:71-72).

Keynes also argued that prices in the short run are rigid and an increase in the quantity of money wouldn't result in higher prices since many of them are set in contracts, a characteristic that especially applies for wages (Friedman & Schwartz 1982:42-51). In some aspect Keynes was right here, since empirical findings do support short-term rigidity for many prices and an increase in the quantity of money usually ends up as price inflation after somewhere around 15-24 months (Friedman 1973:28). He was, however, right for the wrong reasons.

A statement such as the one that prices in the short run are rigid accentuates one of the main differences between the Keynesian view on inflation and the Monetarist view on the same. The basic reasoning of the quantity theory of money is about the purchasing power of money. That is, the difference between nominal and real quantity of money. Nominal quantity is a person's, business' or a country's amount of currency in nominal figures may that be in kronor, sterling pounds or dollars. Real quantity is what the nominal quantity gets you in terms of goods, services, assets etc. It is common knowledge that you get a lot less for 1 Swedish krona today compared to 50 years ago, thus the purchasing power of the Swedish krona has decreased. This process, most likely, comes from the growth in money supply being greater than that of money demand. This states that money and money supply matters regarding the rate of inflation and the purchasing power of money.

To summarise I would like to point out what it implies embracing the quantity theory of money as a general theoretical framework for my thesis. First of all, the demand for money is to be regarded as highly stabile. This doesn't mean that it can't fluctuate, what it means is that the variables determining money demand fluctuates together with the actual demand. This functional relation between the money demand and its variables is, ultimately, what is considered as demand being stable (Friedman 1956:16). Secondly, there are factors that affect the supply of money, which don't affect the demand for money. For example political or psychological circumstances that in turn determine the policies of the monetary authorities (ibid). Last, the scope of what we address as the general price level must include the widest possible selection of goods, services and assets to obtain a correct measurement of it.

As I stated in the introduction, inflation (increases in the general price level) is today usually considered as changes in the consumer price index (CPI). What I aim to answer in the thesis is whether the general price level actually can be referred to as CPI or not. The reasons for why it could be otherwise originate from, among others, classification. The CPI, as given

by its name, is an index of consumer prices or, more precise, of the cost of living. Goods and products like for example property, stocks, and bonds are considered to be assets and are for that reason not included in the index[2]. In more economical terms property, stocks, and bonds, considered as assets, are part of the wealth side in the equation of a budget constraint and not the consumption side.

$$W = P_1 * Q_1 + P_2 * Q_2 + ... + P_n * Q_n \quad (12)$$

The budget constraint in basic microeconomics gives the amount of wealth that can be spent on consumption that in turn brings utility. Today's view on inflation is that it stems solely from changes in the consumer prices (and expectations to some extent)[3], but isn't changes in asset prices also of interest since they affect the budget constraint and thus affect the level of consumption? And also, assets might just be a way of holding wealth for future consumption. Here's where the theoretical argument of Alchian & Klein begins. Instead of studying consumer price levels Alchian & Klein constructed a sort of welfare index stretched over a life time in which they compared the cost of a certain utility level in two time periods. The theory includes present as well as future prices on consumer goods, and assets are used as a mean to predict future consumer prices.

## 2.2 Alchian and Klein and an Iso-utility-based Index

The argument of Alchian and Klein essentially says that when an individual has to spend more actual money for a given level of utility in time period two than in one, the individual has experienced inflation. They present the utility function as a vector of claims to present and future consumption, in which the individual's welfare is the sum of all the utilities from $t_0,...,T$, thus embracing a general theoretical approach regarding assumptions about the individual:

$$U = U([q(i,t)]) \quad (13)$$

The $q(i,t)$ element represents the quantity of the $i^{th}$ consumption service flow at time $t$ (Alchian & Klein 1973:174). Further, the individual's consumption is constrained by the wealth ($W$) possessed by him or her. The wealth in turn is allocated over claims on current

[2] For more information of how, fore example, the Swedish CPI is computed please see *The Swedish Consumer Price Index- A handbook of methods* in the reference section.
[3] The most rational behaviour is to assume the same expectations as the central bank, which leads to the position were CPI is left alone as a measurement of inflation.

and future consumption at present prices on the actual markets. At each current and future moment there are *n* consumption services, which give:

$$W_A = \int_0^{\infty} \left[ \sum_{i=1}^{n} q_A(i,t) p_A(i,t) \right] dt \tag{14}$$

$W_A$ is the individual's nominal wealth, $p_A$ $(i,t)$ is the current rental price and $q_A$ $(i,t)$ the quantity of the $i^{th}$ consumption service for moment $t$. Together they maximize the individual's utility under condition $A$ (Alchian & Klein 1973:175).

If we then change the present prices (which also includes present prices on future consumption services) and keeping the quantities stabile, we can name this new set of prices $B$, thus giving:

$$P_{AB} \equiv \frac{W_B}{W_A} \equiv \frac{\int_0^{\infty} \left[ \sum_{i=1}^{n} q_B(i,t) p_B(i,t) \right] dt}{\int_0^{\infty} \left[ \sum_{i=1}^{n} q_A(i,t) p_A(i,t) \right] dt} \tag{15}$$

If $P_{AB}$ is greater than one the nominal money cost of condition $A$ has increased and inflation has occurred (ibid).

By the look of the formulas the iso-utility index doesn't seem to differ much from the CPI, which also investigates the prices of a set of goods in a time period, which then easily can be compared over time much like in equation (4). The main difference lies in the inclusion of present prices for future consumption services, something the authors call *futures prices* (Alchian & Klein 1973:176).

Futures prices, however, are extremely difficult to measure, since they in many cases aren't available. Therefore, not all futures prices will be observable in direct market prices. Alchian and Klein solve this problem by stating that "*assets are sources of future services*", and thus "*provide clues to prices of present claims on future consumption*". Further, "*Current wealth can be represented by the sum of all asset values, or, equivalently interpreted as the sum of all present valued claims to all consumption service flows over time*". With *m* assets, this gives:

$$W_A \equiv \sum_{j=1}^{m} P_A(j) Q_A(j) \equiv \int_0^{\infty} \left[ \sum_{i=1}^{n} q_A(i,t) p_A(i,t) \right] dt \tag{16}$$

where $W_A$ is the individual's current nominal wealth and $[Q_A(j)]$ is the current vector of asset quantities that would give the utility maximizing consumption services $[q_A(i,t)]$. Then to find a proxy for current futures prices, $p_A$ $(i,t)$, we could standardize assets in terms of their present

and future service flows, and thus the current vector of asset prices, [$P_A$ ($j$)], becomes the proxy for the futures prices (Alchian & Klein 1973:176-177).

If a change in relative prices then occur we can use and determine the vector of assets, [$Q_B$ ($j$)], which yields the minimum cost iso-utility consumption service stream [$q_B$ ($i$,$t$)] with the new asset prices [$P_B$ ($j$)] and implicit futures prices [$p_B$ ($i$,$t$)]. This gives the following equation where $W_B$ is the nominal cost of the vector of assets that will give a flow of present and future consumption services, which yield the same utility as the condition $A$ consumption service stream (Alchian & Klein 1973:177):

$$P_{AB} \equiv \frac{W_B}{W_A} \equiv \frac{\sum_{j=1}^{m} P_B(j)Q_B(j)}{\sum_{j=1}^{m} P_A(j)Q_A(j)} \tag{17}$$

It is important here to understand the differences between the index that Alchian and Klein are trying to create and the regular CPI. The CPI, with its basket of goods, measures the cost of a certain level of utility and by simply comparing the basket's cost in the present period with the former period we can see if inflation has occurred. That is of course true, but the argument of Alchian and Klein (in accordance with the quantity theory of money) regarding the inclusion of asset prices is that if we don't measure asset prices we don't measure the whole concept of the inflation, and therefore miss out of price movements that actually matter to us. Goodhart reaches the same conclusion:

> "*If I spend my money now on obtaining a claim on future housing services by buying a house, or on future dividends by buying an equity, and the price of that claim on housing services or on dividends goes up, why is that not just as much inflation as when the price of current goods and services rises?"* (Goodhart 2001:335)

Assets themselves are on one hand also products or consumption goods and on the other a way of holding wealth, wealth that most certainly will be used for consumption later in life. If an individual instead of buying "regular" consumption goods (i.e. clothes) for his salary buys a portfolio of stocks and bonds or some real estate with the intention of selling it later and then purchase "regular" consumption goods, a mere measure of the price movements of consumption goods brings about a bias in the inflation measurement. The price development of the asset is important to the individual, since it determines the future level of "regular"

consumption that the individual will experience once he sells his asset. That also gives that the measuring of asset price movements is important to central banks as well, since the population will act according to them.

This is even truer if we look at assets as consumption goods, which they often are. There are of course distinctions between different types of assets just as there are distinctions and differences between different types of consumer goods (durables, non-durables, semi-durables etc.). While, for example, stocks are a mere way of keeping, and hopefully increasing, wealth, buying and owning a house has often other grounds then just making a profit out of it. Of course nobody wants to sell his house for less than he bought it, but usually the main reason for buying a house is to live there, not to profit from it once you sell it (if you sell it). What then, essentially, makes the house different from more regular consumption goods, and especially durable goods? Well, basically nothing, but when most durable goods decrease in value a house or, more often, the land it's built on can increase in value. That's nothing unique for houses, since there are consumption goods that can increase in value, such as art, veteran cars, old furniture etc.

As described above, how to categorize the different goods in the economy is not clear. However, it's also not very important for the theoretical approach that I'm applying in this thesis. Why this is so, we'll have a closer look at in the next section, but first I would like to stress the notion of the importance of the long-term relationship between inflation and money growth. Given this thoroughly tested relationship it's important to investigate where the price changes occur. If the money stock is increased by X units of currency, demand is unchanged as well as consumer prices, that means that the price increase has happened elsewhere in the economy. A reduction of a currency's value (higher amount of units in circulation) must be seen somewhere and the theoretical stand point of this thesis is that a price increase in asset prices is just as much of a price increase as one in consumer prices and should be accounted for in what we normally call the general price level.

## 2.3 The Construction of the Price Index

The first question that we'll have to deal with regarding the construction of an index that better corresponds with our theoretical course is what should be included and what should be left out. The CPI isn't in any way harmonised between different countries and is therefore measured and calculated differently over the world. But more or less true is that it solely

focuses on consumption goods to find out the overall price movement in this sector of the economy. The non-harmonised way of calculating the CPI also makes it a non-sufficient measure of inflation when it comes to comparing inflation between countries.

A more formalized way of measuring inflation is the GDP-deflator. It measures the overall price movement of all that has been produced over the time of the analysis, e.g. a year. This can of course be a good indicator of the level of inflation, but at the same time the GDP-deflator misses out on a lot of price movements, not only asset prices, but also existing consumer goods.

The dominating measures of inflation are thus focused on either consumption goods or recently produced goods. Some asset prices, e.g. housing, are sometimes considered through different calculations of the cost of living and shelter. These calculations though are usually based on the cost of owning or renting a house or an apartment and not on the actual price of buying it. Price increases in the housing sector that correlate with the lowering of the interest rate will therefore go unnoticed in the CPI (see Wynne 1999 for details regarding different price indices). The main problem with this approach is that the share of income that the households spend on assets is substantial. Back in 1999 Goodhart found that the average British household spent 18.5% of post tax income on house purchases through mortgages and 5.5% of its post tax income was made out of financial savings (Goodhart 2001:335). It would therefore seem reasonable to include asset prices in the inflation measure, since they, obviously, account for a large share of our income and spending, which also means that they matter to the population.

Theoretically speaking there are even more arguments. For the quantity theory to hold true the scope of what we measure must be total, since everything else would result in an erroneous price level in the equation. Fisher therefore states the following regarding the construction of an index:

> "*This includes purchasing power over everything purchased and purchasable, including real estate, securities, labor, other services, such as the services rendered by corporations, and commodities.*" (Fisher 1911:218).

Alchian and Klein follow in the same path when writing out details of what to include in the iso-utility index:

> "*It is crucial to emphasize that the vectors [$Q_A$ (j)] and [$Q_B$ (j)] must include all assets –consumer and producer, durable and nondurable, tangible and intangible, financial and nonfinancial, human and nonhuman. All sources of present and future consumption services must be considered.*" (Alchian & Klein 1973:177).

The theoretical distinction between different kinds of assets, goods and services thus becomes unnecessary. It's all part of the economy, it's all something we buy or sell and it all affects our economic situation as well as our utility. However, the index is problematic to construct. There's a lack of data regarding a number of variables and it's also hard to know when we've included absolutely everything. But never the less, an index including more goods and assets than the CPI should bring about a slightly better measure of the level of inflation, since it measures a wider range of the price developments in the economy.

There are more aspects to be considered when designing a price index, but since those questions are of a more methodological nature they will be discussed in the next chapter.

## 2.4 Evaluating the Index

Having considered the theoretical aspects of what a price index should consist of, it is time to try to evaluate it empirically. The reasoning behind the evaluation is that if the monetary authorities were fed the wrong information regarding the actual price level, they would've notoriously been setting an erroneous interest rate in respect to the actual rate of inflation. This, in turn, might have spurred the economy when it should've been cooled down and vice versa. The most interesting time period regarding this will be the time leading up to the dot-com bubble and the present financial crisis. A common partial explanation regarding the present crisis is that the Federal Reserves set the interest rate too low following the 9/11-attacks. But, since I can't repeat history and make the monetary authorities act according to my hypothesis I need to try to re-enact or simulate central bank behaviour. To do this I use the Taylor rule, which is explained more thoroughly below.

### 2.4.1 The Taylor Rule

First put forward by John Taylor in 1993, the Taylor rule is a policy rule developed for central bankers as a way to set the nominal interest rate. One of the ideas behind the rule is that it will

bring about stability in the economy, since the actions of the central bank would already be more or less known to the private sector. Taylor stated the rule as follows:

$$r = p + 0.5y + 0.5(p - 2) + 2 \quad (18)$$

where $r$ is the nominal interest rate (federal funds rate), $p$ the rate of inflation over the last four quarters, $y$ the percentage deviation of real GDP from target (percentage output gap) (Taylor 1993:202).

The rule later changed somewhat, since it was discovered that the "0.5"-variables didn't need to exactly take on the value of 0.5 (which Taylor himself also acknowledged). The value of the variables instead should depend on what economic situation that is present and what the central bank wishes to achieve. The first variable regarding the output gap (let's call it $b$) should in almost every case be positive. The exception is when supply shocks are all dominant and the central bank wishes to minimize the variance of the output. In this situation the $b$-variable takes on the value of 0. In the same way monetary policy regarding interest rates should be counter-cyclical, that is, the second "0.5"-variable (let's call it $h$) should be greater than 0. The exception is when supply shocks are dominant and the central bank wants to stabilize inflation (Sørensen & Whitta-Jacobsen 2005:616-617).

The development of the rule also brought about an insertion of the real interest rate variable $r$. The small re-makes of the rule made it look the following:

$$i = \bar{r} + \pi + h(\pi - \pi^*) + b(y - \bar{y}) \quad (19)$$

where $i$ is the nominal interest rate, $\bar{r}$ the assumed equilibrium real interest rate, $\pi$ the rate of inflation over the last four quarters and $\pi^*$ the inflation target, $y$ the real GDP and $\bar{y}$ potential GDP (Sørensen & Whitta-Jacobsen 2005:611).

Equation (20) is the equation that I use as my Taylor rule when it comes to deciding what interest rate the central banks should've set in the light of another type of inflation data. I'll expound this in a more detailed manner in the method chapter.

# 3. Method

In this chapter it will be dealt with how I aim to perform my creation of a price index. I account for how to undertake a systematic approach to the construction of a price index, mainly regarding the weights that will be given the different assets and goods. There's also a discussion about other important aspects when constructing an index such as consistency and the variables effect on output. Last but not least, I take a section to discuss every economist's best friend as well as worst enemy – the data.

## 3.1 Settings and the Index

The formation of the index that I'm aiming to create is to some extent restrained by the data I'm using. The data itself and the time range of the data aren't always satisfactory and my selection of countries is therefore based on the availability of data from the actual countries included in the analysis. Throughout my analysis I use two indices; one based on main CPI-groups and other variables, and one more deep-going index based on the lowest possible level of disaggregation of the data. The first index is created for 6 countries namely; Australia, Japan, Norway, Sweden, Switzerland and The United States. The index based on the lowest possible level of disaggregation will be created for Sweden, since it's the country with the best overall statistics.

When it comes to the level of disaggregation the rule of thumb is that the lower the better. This is especially true for the CPI-data, but there is, in my opinion, a problem here. A lot of the data regarding asset prices are collected on more of a group level than the disaggregated CPI. There is one index for price developments within the housing sector instead of one for every type of housing, which would have been the case if we were to look at it in the same way as at the CPI-data. The same goes for shares, which are collected in one share price index. Hence, there could be a problem with the weighting of the index if the data is on different levels of disaggregation, since, there is more room for price fluctuations within a single good than within a group of goods.

Finally, I construct my alternative measure of inflation by multiplying the change in price of the variables with their weights and then adding them all together:

$$\pi = \left(\left(P_{i,t} - P_{i,t-1}\right) * w_i\right) + \left(\left(P_{j,t} - P_{j,t-1}\right) * w_j\right) + \ldots + \left(\left(P_{n,t} - P_{n,t-1}\right) * w_n\right) \qquad (20)$$

Another statistical aspect of this type of index is how we deal with the residual values. I assume here that the residuals have a normal distribution, resulting in an average value of 0. What we get then is:

$$\begin{aligned} &\Pi_t^i = \Pi_t + \varepsilon_t^i \\ &\varepsilon_t^i = 0 \\ &\frac{1}{T}\sum\nolimits_T \Pi_t^i \end{aligned} \qquad (21)$$

where the sum of all $\Pi_t^i$ through all time periods gives us the general price level.

The blue prints for the index are accounted for. What's left now is to find out how to obtain correct and reasonable weights for the different variables of the index. In the next section I present a statistical method of how to calculate variable weights for the index.

## 3.2 How to Weigh the Variables

There are different ways of addressing a certain weight to a certain variable in an index. The Swedish statistical institute mainly uses different surveys of household expenditure to determine their weights in the Swedish CPI, Konsumentprisindex (KPI) (Statistics Sweden 2001:24). The KPI, together with other CPIs, consists of a fair share of other methods as well. These aren't accounted for in the CPI handbook (Statistics Sweden 2001), and are of smaller value to the index compared to the household surveys that are the foundation of the index (Ibid). Common praxis has it that some of these methods have an element of experience and know-how based handling of the construction of the CPI in them. This as well as more scientifically supported methods that I've written about above.

In my analysis I have chosen a more mathematical approach. I'm using a least-variance formula that basically states that when a variable is volatile it will be given a smaller weight compared to more stabile variables. This formula given below has also been used by Cecchetti et al. 2001 and looks the following:

$$w_i = \frac{\frac{1}{\sigma_i^2}}{\sum_{i=1}^{N} \frac{1}{\sigma_i^2}} \qquad (22)$$

where the weight given to good $i$ is $w_i$ and the variance is $\sigma^2_i$ .

The main reason for using this method is stability[4]. An overall price index shouldn't fluctuate too much, since this would most likely lead to economical instability and, in the long run, distrust of the index. One of the main problems with the computations made by Alchian and Klein was that volatile asset prices got too large weights within their index, thus rendering instability to the index. Therefore one of the main ideas behind this index technique is to give goods or assets with volatile price movements a small weight, so that their overall effect on the index doesn't become too big. However, while taking in to account volatile variables one must be aware of overly stabile variables as well. An example is the price evolution of *Games of choice* in Sweden that according to this method receives a weight of over 30% in the detailed index, which it most certainly shouldn't have regarding its impact on the economy. This is probably due to the fact that this sector is a state monopoly in Sweden and that it obviously has had a very foreseeable development path and very small price movements. I will show the implications of such a variable, and also the reasoning of why it should be excluded, in a more detailed manner in chapter four. Either way, on average I believe this is a good method for finding out indications of what weight that should be given to different goods in the price index.

When constructing a price index there are a few main aspects to consider. Of course we want the price index to be as correct at possible, but it's hard to find an all-over systematic way of constructing a perfect index, thereof the element of experience in an arbitrary way within the CPI-indices. This is also connected with the economic impact of the variables or goods in the index. An index that underestimates the weight of an economically very "heavy" good for the sake of systematics is a problem since it will result in a faulty level of inflation. Just as an index based more on experience and know-how within the statistical institutes easier could lose credibility due to its lack of systematics. How could you trust or check up on something that you have no idea of how it has been created? In an ideal world there would be a 100-percent systematic way of determining the inflation level solely based on a grand formula that brings about the correct inflation rate. Unfortunately, this is not the case. Therefore the inflation measure in practice, in general as well as in my thesis, will be an act of balance between the variables effect on output and the level of systematics.

Further, I would also like to add a few words regarding the importance of consistency. One should be careful of imposing too drastic changes in the measure of inflation, since

[4] For thorough mathematical exposition of this type of index look up Diewert 1995.

there's great value of being able to see certain price developments over the years. A somewhat incomplete and fairly functional measure could therefore be preferred to a measure that seems to be more correct, just because there's a great value in being able to make comparisons with earlier levels of inflation as well as it's important with economic stability, even a perceived one. But, if the index is so faulty that it delivers substantially wrong information regarding the rate of inflation it should of course be changed for a better one. Therefore, also the question of consistency comes down to an act of balance between the value of time comparisons and stability and to what extent the index actually measures what it's set out to measure – namely, inflation.

## 3.3 Data

The data used in the thesis is mainly collected from either national statistical institutes or renowned organisations such as the IMF or OECD. The ever present problem is of course data coverage for all my variables. In some cases the problem is the time span, and in some cases that I haven't been able to find proper data. In every test I try to stretch the analysis as far back as possible, but when the data stretches over a period of less than 20 years I've decided that it's too short of a period for statistical analysis of this type.

## 3.4 Interest Rate Setting

After having constructed my index and received a level of inflation apart from the CPI, it's time to investigate if the central banks should have acted differently given other inflation data. Setting a proper interest rate according to the data I have available is difficult, and I therefore use the Taylor rule, which has gained widespread acceptance as a functional policy rule when it comes to monetary policy. Though not explicitly followed by central banks over the world, the results from using it correlate fairly well with the actual behaviour of central banks (New York Times 1, Clarida et.al. 1998). My fictional central bank will therefore follow the Taylor rule.

### 3.4.1 Working in the Taylor-rule Framework

As stated in the theory chapter the Taylor rule is a way of finding out which short term nominal interest rate to set. My comparison consists of four interest rates; one given by my

measure of inflation in the Taylor rule, one given by an ordinary Taylor rule with the CPI as a measure of inflation, one given by a Taylor rule based on the GDP-deflator and one given by the actual short-term nominal interest rate that was set by the central banks. This gives me the possibility to see how much the Taylor-rule decision deviates from the actual decision.

The interest rates are then plotted against the three types of inflation data to find out if an alternative measure of inflation would've signalled a higher rate as a response to the upcoming crisis.

# 4. Analysis

Since the CPI and the collection and classification of data to the CPI varies from country to country I've decided to analyze each country individually at first, and then later, see if there are any general conclusions that can be drawn.

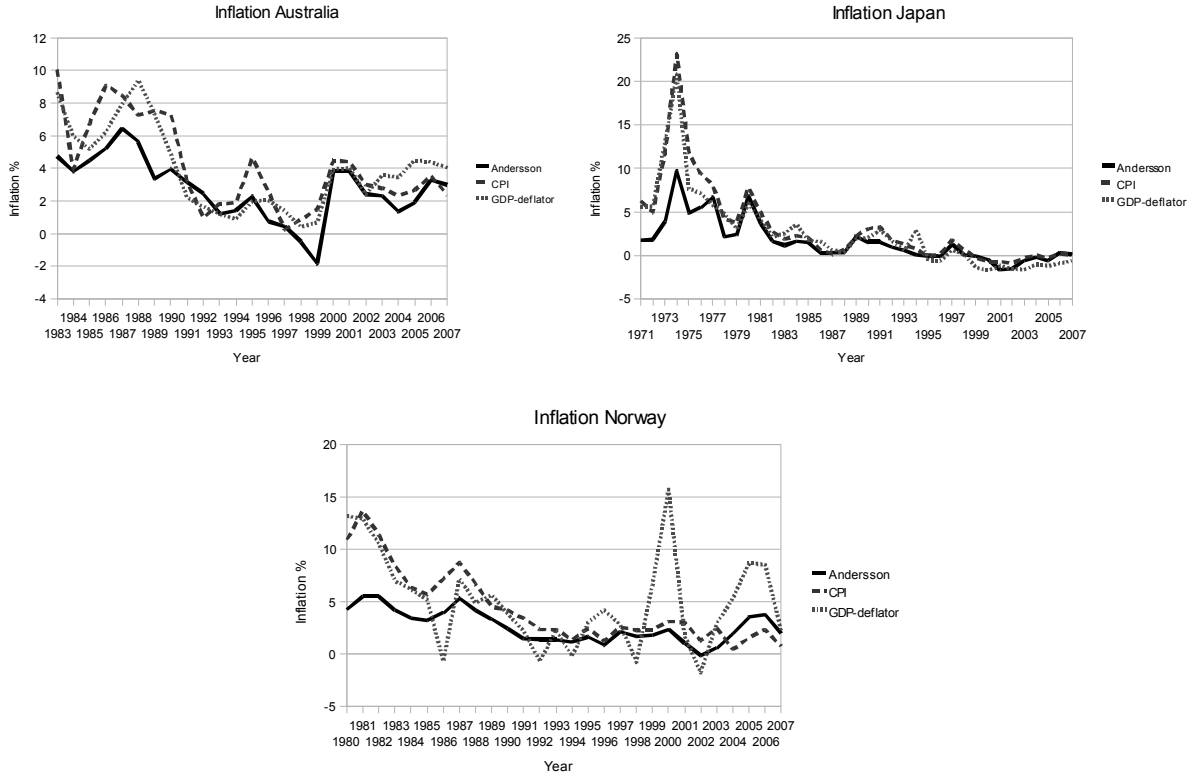
The analysis chapter starts of with the indices made on the CPI main groups plus asset and other prices, followed by the detailed index of Sweden and, last, the Taylor rule will be applied to the results to see if the nominal interest rate could've been set in another and, perhaps, better way.

## 4.1 The Long-term Index Weight

For over-all readability I have chosen not to display all my weightings in tables in the analysis chapter. Instead I have put them all in an appendix at the end of the thesis. In the appendix I've also included the actual Swedish CPI group weights from 2000. This, since my computed weights will have little or no relevance to a reader not familiar with price index weighting and by presenting the reader to the actual weights I thereby give him or her something to measure my weights against.

### 4.1.1 Group-based Indices

Chart 4.1 Inflation Indices – Australia, Japan and Norway




The main stack of data for Australia covered the period from 1973-2007. There were, however, some CPI groups where the data was insufficient. These were: *Postal Charges*, *Restaurant Meals*, *Electricity*, *Education*, *Recreation* and *Health* (from 1981, 1981, 1981, 1982, 1990 and 1990 respectively). The data for wages was also insufficient stretching only from 1987 and onwards. Wages are not an asset, but are still a variable that is worth keeping track of since they are the price of labour and they are also included in Fisher's index.

Following up on these shortcomings I made indices starting from 1990 as well as from 1982 just to compare with the 1973-index and the differences were substantial. Some variables' weights increased or decreased by more than a hundred percent. The time frame for the index is therefore of high importance. On the other hand one doesn't want to exclude goods, services or assets that should've been part of the index, because it would lead to a bias in my calculations. However, since my method of calculating the weights is based on variance it seems to me that the data span regarding time is a bit more important than a wide selection of data. At the end, a slightly wrong/biased index is preferred to one that has improper

weights. However, in the appendix I present the 1973-2007-index as well as the 1982-2007-index, since there are a great amount of variables that fall out of the index otherwise.

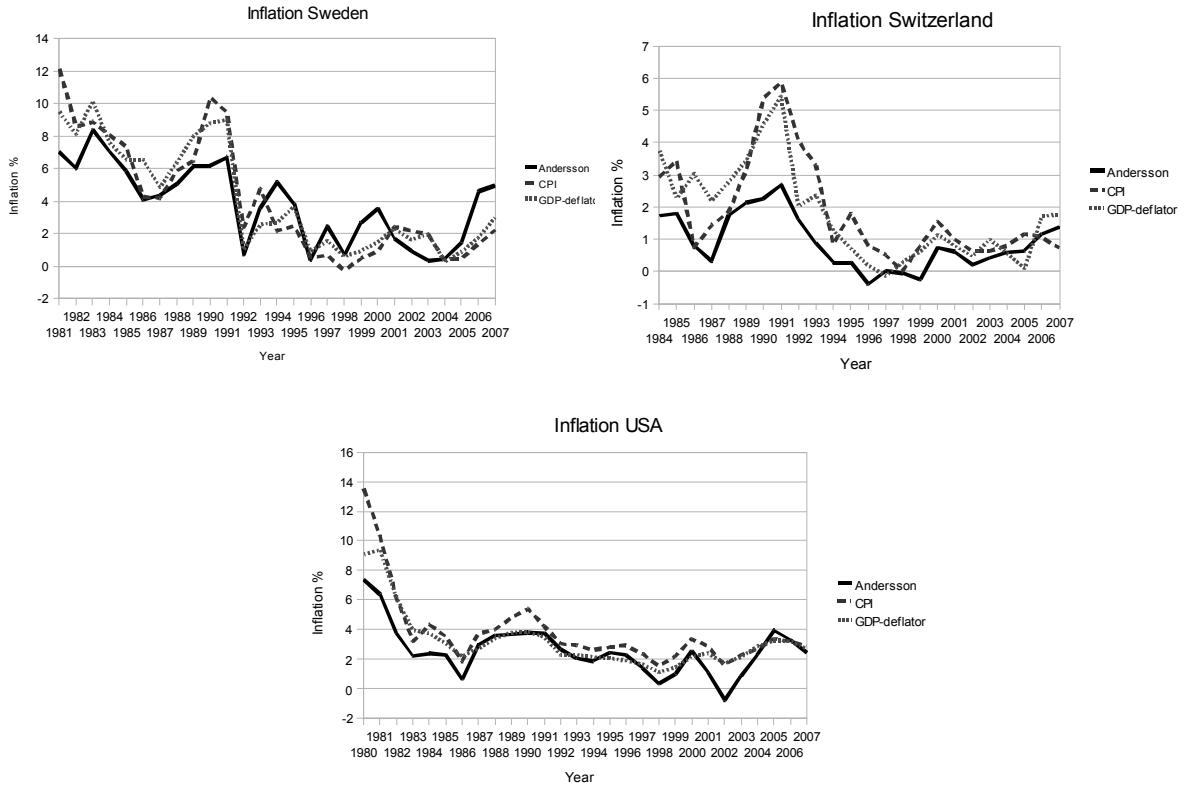
The remaining task now is to choose which weights to use when constructing the index. In the graph above I use the 1982-2007-index. There are several reasons for doing so. First, it contains more variables and therefore gives a better oversight of the overall price movement in the economy. Secondly, I consider 25 years as a long enough time span for the analysis, despite the fact that a 34-year long period would probably give an even more correct long-term defined weight. The third argument is connected with the first and it's based on a somewhat subjective opinion that the variables that are included in the 1982-2007-index are "valuable" variables in the sense that they're given quite substantial weights as well as having a significant impact on the total economy. I consider for example electricity to be of great value to a price index, since we consume substantial amounts of it. Therefore, the first and third argument are considered more important than having as long a time line as possible. Especially given that a time line of 25 years is enough in this case.

As can be seen in the graph depicting Australia the three indices to some extent follow the same path or general trend, but still differ quite a lot at certain moments. Worth noticing is how the Andersson index shows substantial deflation of around two percent in 1999. However, the interesting part will follow later when I put the results into a Taylor-rule framework.

Japan was another country with good data coverage. Here I managed to get data series all the way back to 1970 for all my chosen variables. The Andersson index follows the same path but on what seems to be a somewhat lower level or, at least, it's less drastic in its path than both the CPI and the GDP-deflator. Even though Japan is known for its "asset problems" the Andersson index doesn't really show any other inflationary trends than the CPI and GDP-deflator indices.

Regarding Norway the Andersson index is once again overall lower. An interesting aspect is that the Andersson index indicates a rise in inflation earlier than the CPI after the burst of the dot-com bubble in the beginning of the new millennium. A possibility, however a bit far-fetched, is that the central bank in Norway then responded too slowly to the rising inflation and kept the interest rates too low for too long. This part of the analysis will be investigated further later on.

*Chart 4.2 Inflation Indices – Sweden, Switzerland and USA*




The Swedish index is the first of two types of indices that I construct. This one is based on group-level variables and when put together in an index the trend from the former indices, where the extended Andersson-index has more or less looked like a weaker version of the CPI, is gone. Noticeable is that in the run-ups to both the burst of the dot-com bubble and the sub-prime crisis the Andersson index has signalled a higher inflation and, hence a recommendation of a higher interest rate.

In the case of Switzerland I had to cut the *Health care* variable, since the series started in 1993 and thus provided a too short time span. Otherwise the data set was fairly complete, with all variables starting from 1983. The Swiss index takes the form of a smoother and a bit lower general price movement, than the CPI and the GDP-deflator.

For the US I was able to find good CPI-data, stretching back to 1970. However, I had to shorten the spectrum of the analysis and start from 1980, since I couldn't find any index for stock prices reaching further back. And since stock prices are prices of assets, which play a main role in my analysis, I felt that an index without them would undermine the purpose of the analysis. Also this index takes on a lower path than the two other indices. Interesting to notice is the sharper incline from 2002 to 2005, where the low interest rates of the Federal Reserves spurred the American asset market.

### 4.1.2 Detailed Index of Sweden

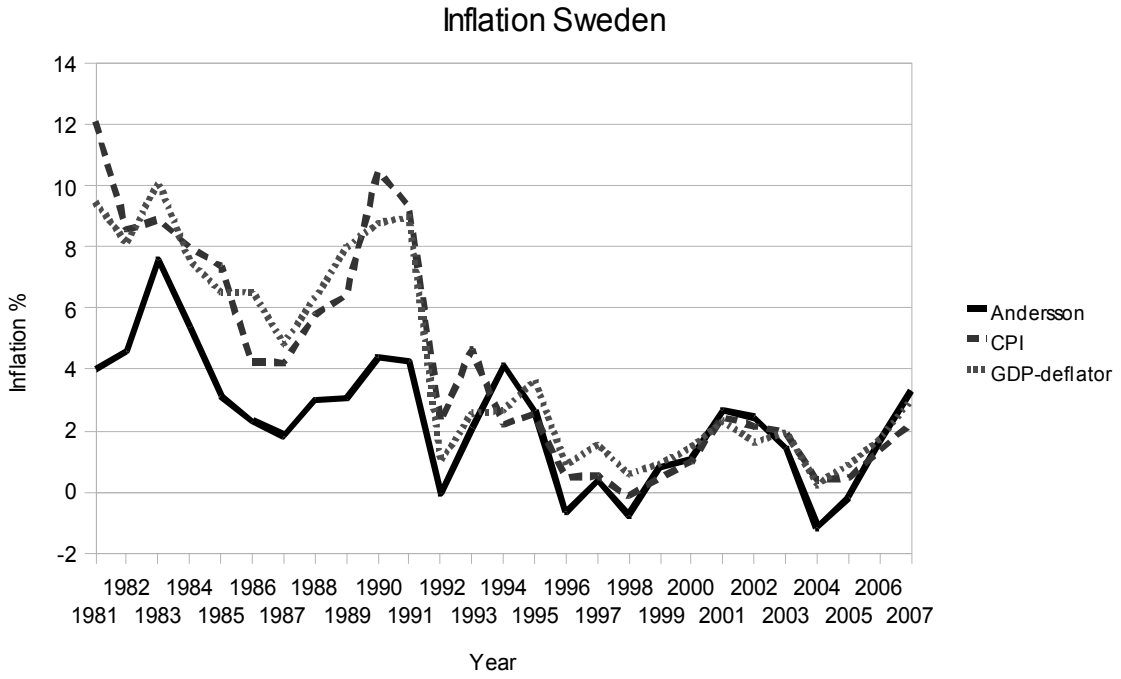
In this part of the analysis I present the weights of the variables apart from the CPI that I included (in total there were more than 100 variables). They're shown in table 4.9 below.

*Table 4.1 Sweden 1980-2007*

| Variable | Weight |
|---|---|
| Share Prices | 0.006109 |
| Wages | 0.000895 |
| House Prices | 0.000232 |
| Producer Prices | 0.030772 |

The generated index is presented in chart 4.3:

*Chart 4.3 Inflation Index Sweden - Detailed*



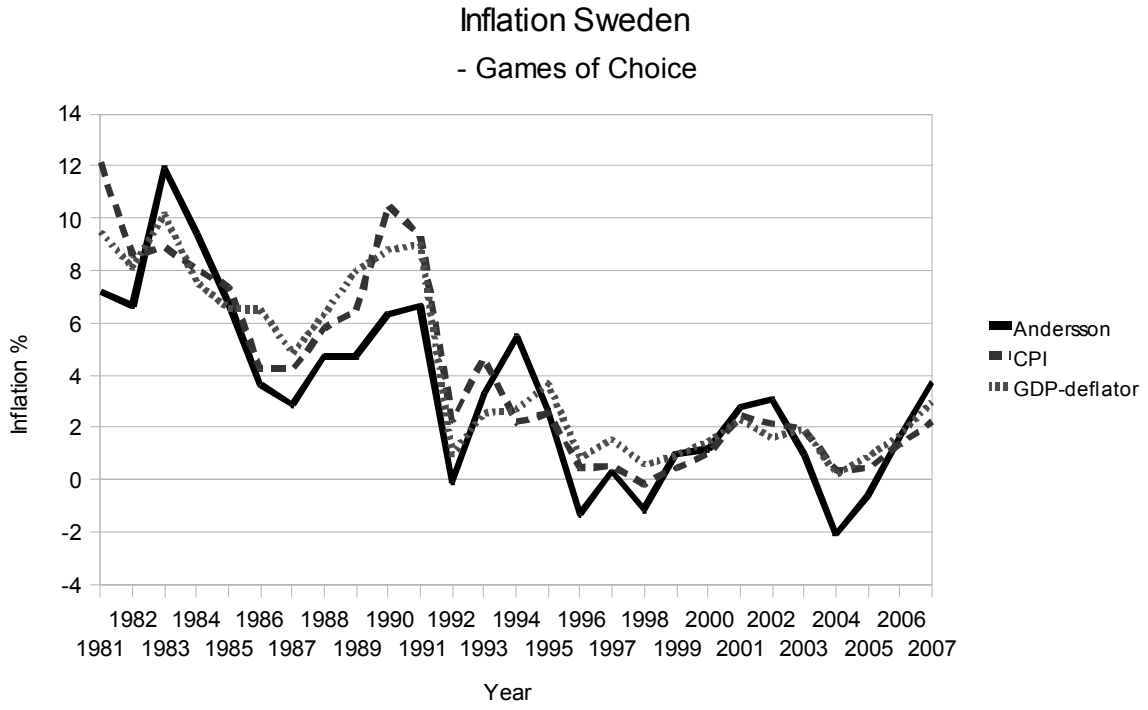

As I mentioned earlier in the method chapter, the variable for *Recreation & Culture – Games of Choice* received a very high weight when computing the index, 36%. Even though my method is statistically based and the variable has been very stabile (probably due to the gambling monopoly) it seems unrealistic that this variable should account for more than a third of a general price movement, especially on this level of aggregation. The variable was removed and the resulting weights of my "asset variables" were:

*Table 4.2 Sweden 1980-2007, minus Games of Choice*

| Variable | Weight |
|---|---|
| Share Prices | 0.009589 |
| Wages | 0.001405 |
| House Prices | 0.000363 |
| Producer Prices | 0.048303 |

The index is given in chart 4.4:

*Chart 4.4 Inflation Index Sweden 2 – (Detailed)*




The removal of the variable *Games of choice* resulted in a somewhat different picture, especially during the 80's. The Andersson index now seems to be more volatile than both the GDP-deflator and the CPI. That's usually considered to be a bad feature in a price index, since stability and the long-term trend are of value when setting the interest rate. A central policy that has a high amount of volatility in it also, in my opinion, signals uncertainty, which doesn't help to encourage investments in a country, and is therefore bad for the economic growth.

On the other hand the price changes do take place and, volatile or not, they should be considered and reacted upon. They're still part of the economy, they're still bought and sold and they still matter to people, companies and the government. And if one variable takes on a

too big of a weight I think there is reason to exclude it. Therefore, from now on I use the index that doesn't take the category *Games of Choice* into consideration.

## 4.2 A Moving (expanding) Window Technique

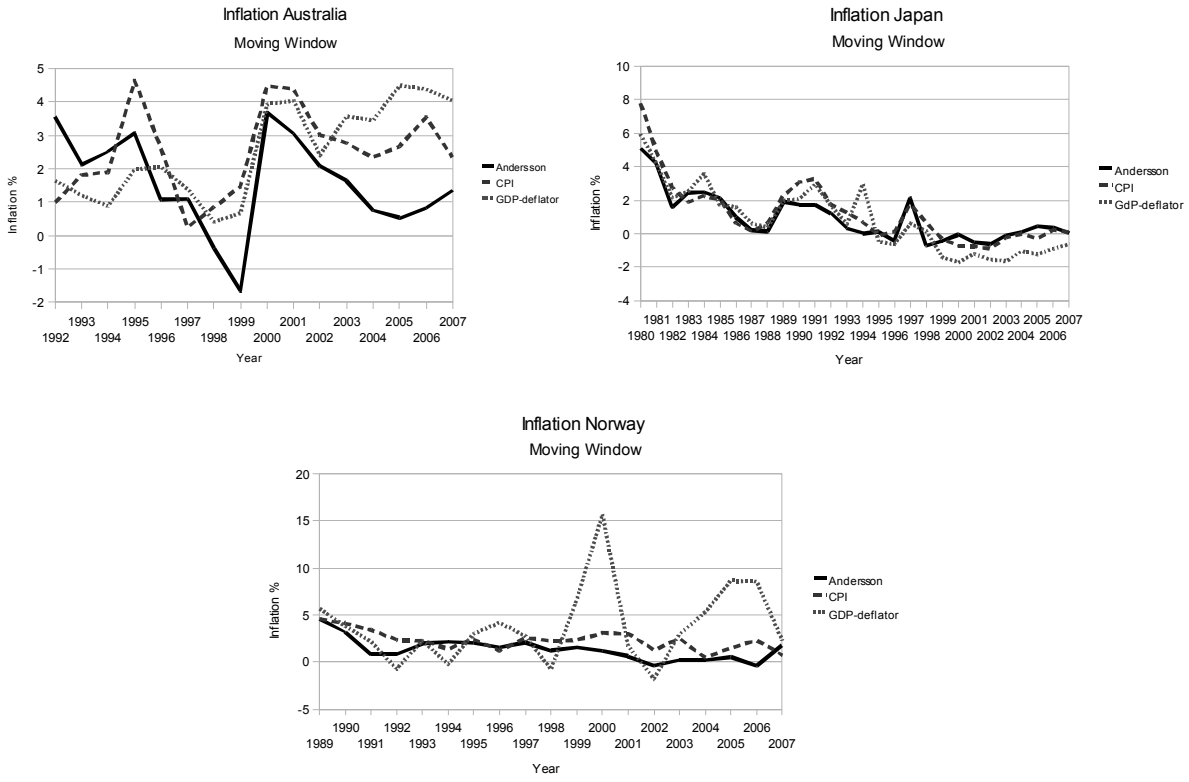
In the last sections I presented the long-term weights for the chosen countries. All of them on a group level and I also performed a more detailed investigation of the Swedish index with a lower level of data aggregation. The Andersson index often turned out as a smoother more trend-like index than the CPI and the GDP-deflator. That outcome is expected since the weights of the index are based on the whole timeframe of the analysis and therefore should give a more long-term based index.

When putting my results into a Taylor-rule framework it would be wrong to use these weights, since the central bank when setting the interest rate for 1995 hardly can look at an inflation index with its weights partly based on a time span that is yet to occur. I also believe that these weights, though useful in the long run, might miss out on actual trends in certain goods and assets. An example would be a good that during the 80's and 90's has little or no increase in its price. Then suddenly during the running up towards the dot-com bubble it starts to increase drastically. An index weight based on the long run would not take into account the recent price increase, which might be of value to the overall inflation or the economy as a whole.

For the above-written reasons my fictional central bank works with a ten-year window when weighting their index and setting their interest rate. That is, their weights are based on the ten latest years of continuous price developments. So when my fictional central bank sets its interest rate in for example 2003 it then looks at the inflation levels according to one of the indices (Andersson, CPI, GDP-deflator) from 1993 and onwards.

## 4.2.1 Group-based Indices

*Chart 4.5 Inflation Indices – Australia, Japan and Norway*

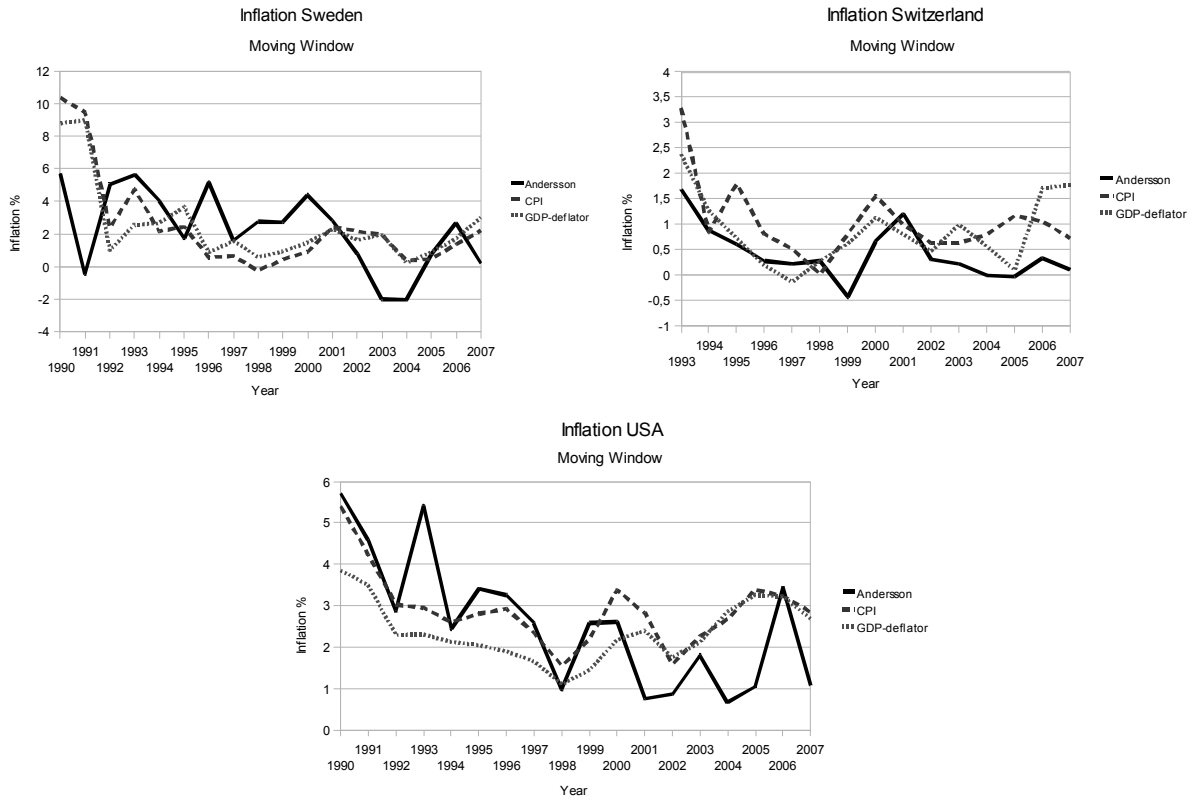



This comparison shows that the Australian central bank more or less constantly has set a too low nominal interest rate according to the Andersson index. The index also shows deflation in 1999 and then almost a four percent inflation in 2000, which seems rather unlikely. Nonetheless, the CPI and GDP-deflator indices also show drastic increases in inflation from 1999-2000.

In the Japanese case the different indices are quite similar. All of them showing low levels of inflation, especially from 1998 and onwards.

The GDP-deflator in the Norwegian case really captures the dot-com bubble, which is usually said to have affected the countries of Scandinavia, North America and the UK strongly. With that said it's always important the keep in mind the special attributes of the Norwegian economy, mainly the large incomes from their natural resources, which, contrary to Sweden, may have spared the Norwegian economy somewhat when the dot-com bubble burst. The natural resources may also be the reason why the GDP-deflator increases more than the other indices from 2002-2006, a period with sharp increases in the world oil price.

*Chart 4.6 Inflation indices – Sweden, Switzerland and USA*



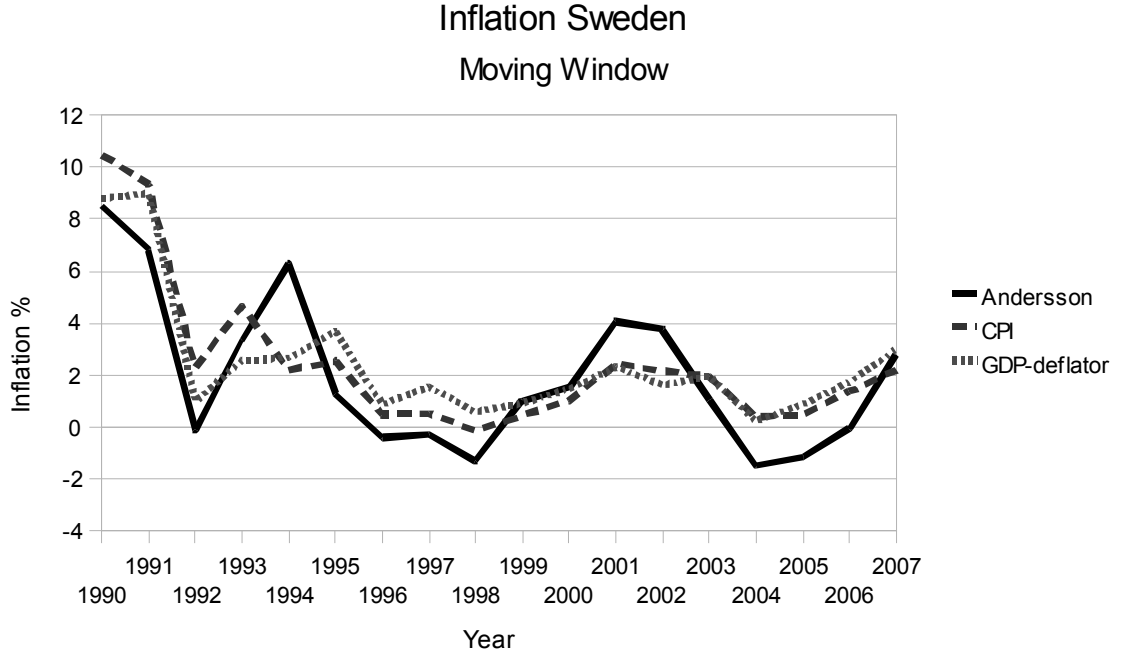

The Andersson index shows rising inflation during the late 90's leading up to the dot-com bubble in the Swedish case. In the same way it's noticeable how the stock market catches up with the rest of the economy during 2003-2006, which was a period of great stock market growth in Sweden. It's worth noticing here that the Andersson index in this setting is a bit more volatile than in the detailed index, which of course is due to bigger weights in the overall indexing, thus making the more volatile markets of stocks and housing matter more for the total picture than in the detailed index in chart 4.7.

Nothing in the Swiss index indicates that the Andersson index would've foreseen the dot-com bubble or the present sub-prime crisis in any other way than the two other indices: it's rather the other way around.

In the US case the Andersson index takes on a volatile character, in contrast to the CPI and GDP-deflator indices, that move in a more unison way. The Andersson index in this aspect does not signal the dot-com or the sub-prime bubbles.

### 4.2.2 Detailed Index of Sweden

*Chart 4.7 Inflation Index Sweden 3 – (Detailed)*




Now we can see that the Andersson index performs differently than earlier. It now responds heavier to the stock market growth in the late 90's and also shows rising inflation trends in 2006 and 2007, thus signalling stronger than the CPI and GDP-deflator indices of the upcoming problems.

To summarise part 4.2.1 and 4.2.2 of the analysis one can say that straight away it's hard to see any clear and consistent results among the countries. Instead, the way the Andersson index performs varies quite substantially between the different indices. This could be due to data selection, or perhaps due to other reasons? Either way, it is time to put the data into a Taylor-rule framework and try to find out how central banks could've acted upon the new information that the Andersson index presents.

## 4.3 The Taylor-rule Framework

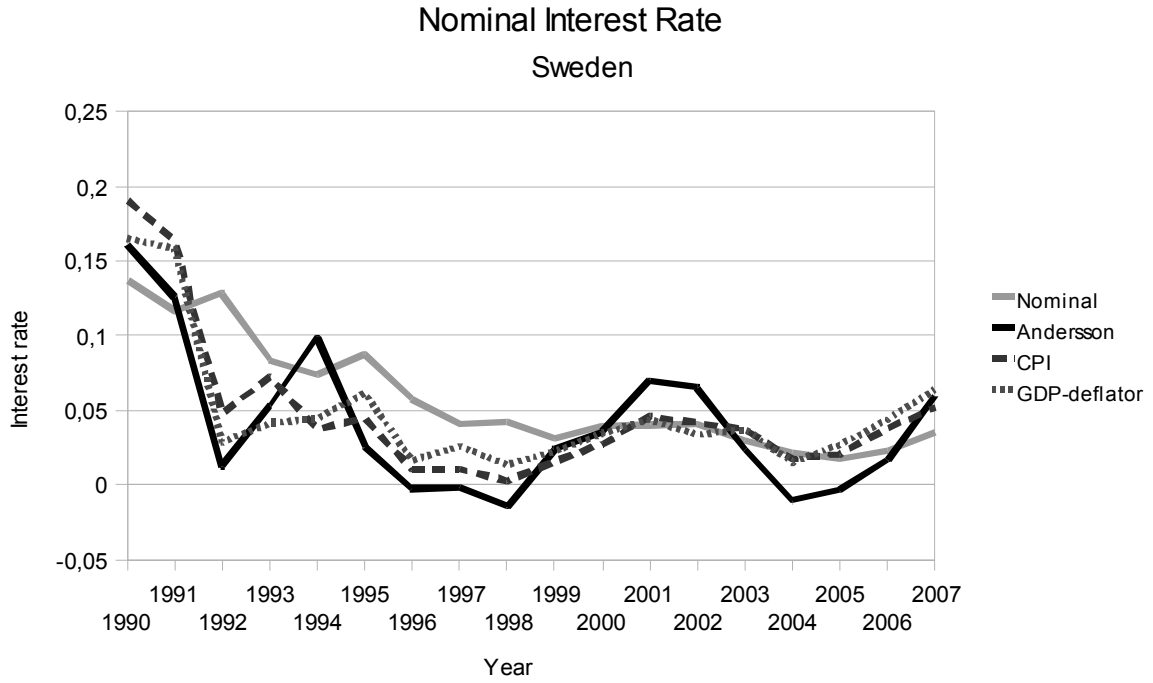
Since the Swedish index with the lower level of aggregation is my main point of analysis I'll start off by putting that data into a Taylor rule and then analyse the outcome. Later on the group-based indices will be dealt with in the same way.

There's, however, one problem with the Taylor rule. The variable *assumed equilibrium real interest rate* is of natural reasons hard to determine. According to Fisher the real interest rate is the nominal rate minus inflation (About.com 1). As that might be, the problem in my case is that I have different measures of inflation and therefore can't stick to anyone of them within the equation. I therefore have to have a value for the *assumed equilibrium interest rate* that derives from something else then the nominal inflation rate. In the long run the average real interest rate is considered to be the equilibrium real interest rate since one of the major assumptions in economics is that the economy reaches equilibrium in the long run. The average real equilibrium rate in the long run is equal to average real GDP growth, which is the measure that I use as the variable for assumed equilibrium real interest rate.

### 4.3.1 Detailed Index in a Taylor-rule Framework

The settings for the Taylor rule are as described in the method chapter. I set the inflation target to 2%, which is the average of Sweden's inflation target, which is between 1-3% (Swedish Central Bank 1). I use a standard value of 0,5 for the *h* and *b* variables keeping them constant throughout the analysis, thus minimising their influence in the comparison. That also seems like an honest way of conducting the analysis instead of trying to fit the data to the equation.

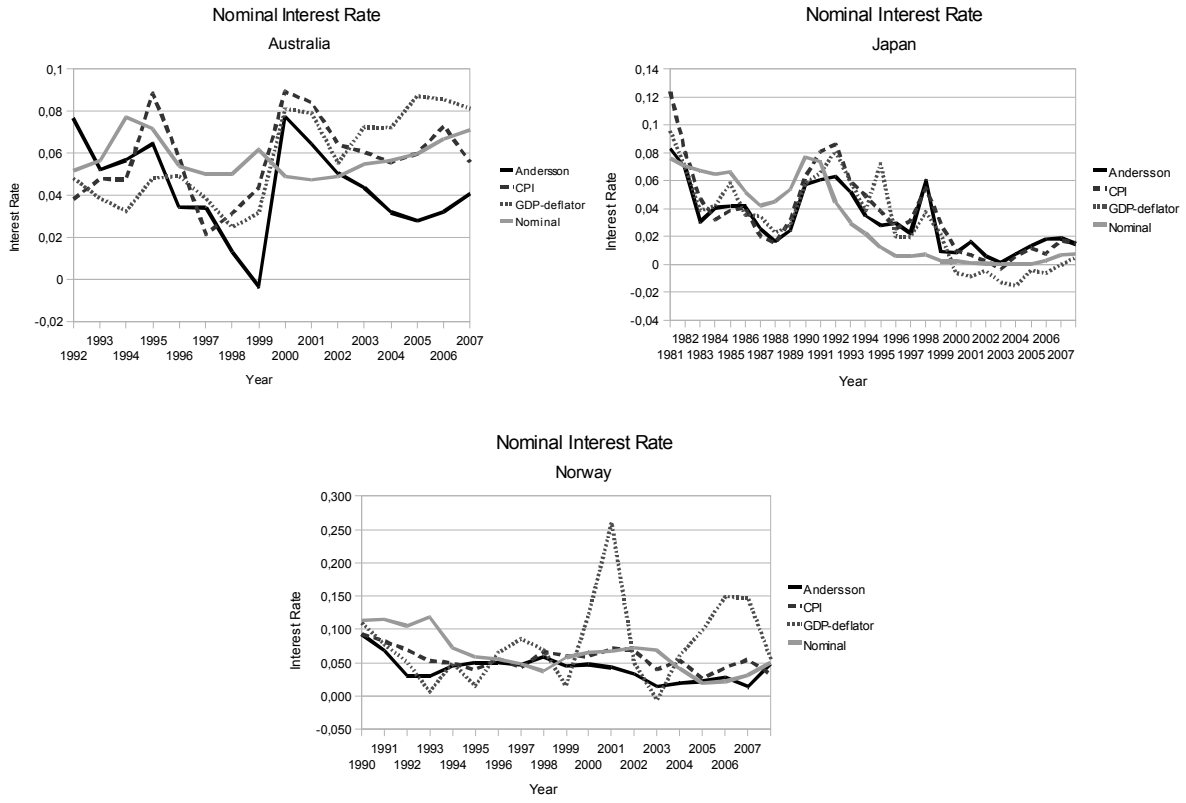
*Chart 4.8 Comparison of Interest Rates (Detailed)*



As shown by the index, the interest rate based on the Andersson index is the index that reacts hardest to the dot-com bubble. One interesting aspect is that the CPI as well as the GDP-deflator in a Taylor rule both signals a sharper rise in the nominal interest rate than the actual rate that was set by the central bank. Regarding the dot-com bubble the Andersson index is the only index that deviates from the other ones, which is probably mostly due to the inclusion of share prices in the index, which, in turn, gives support to the inclusion of asset prices when it comes to predicting and, to some extent, preventing bubbles. But, with that said, it should be noted that the Swedish central bank held a higher interest rate during the late 90's than any of the indices recommended. The reaction of the Andersson index is somewhat late with its highest values in 2001 and 2002, when the bubble had already burst. Also the idea of having a negative interest rate in 1998 doesn't really coincide with bubble prevention.

### 4.3.2 Group-based Indices in a Taylor-rule Framework

*Chart 4.9 Comparison of Interest Rates – Australia, Japan and Norway*




Australia uses an inflation target of 2-3% (Australian Central Bank 1), hence in the Taylor equation their target is set to 2.5%. The first insight is that the Australian central bank probably doesn't use a Taylor rule for decision making. All three inflation measures react to

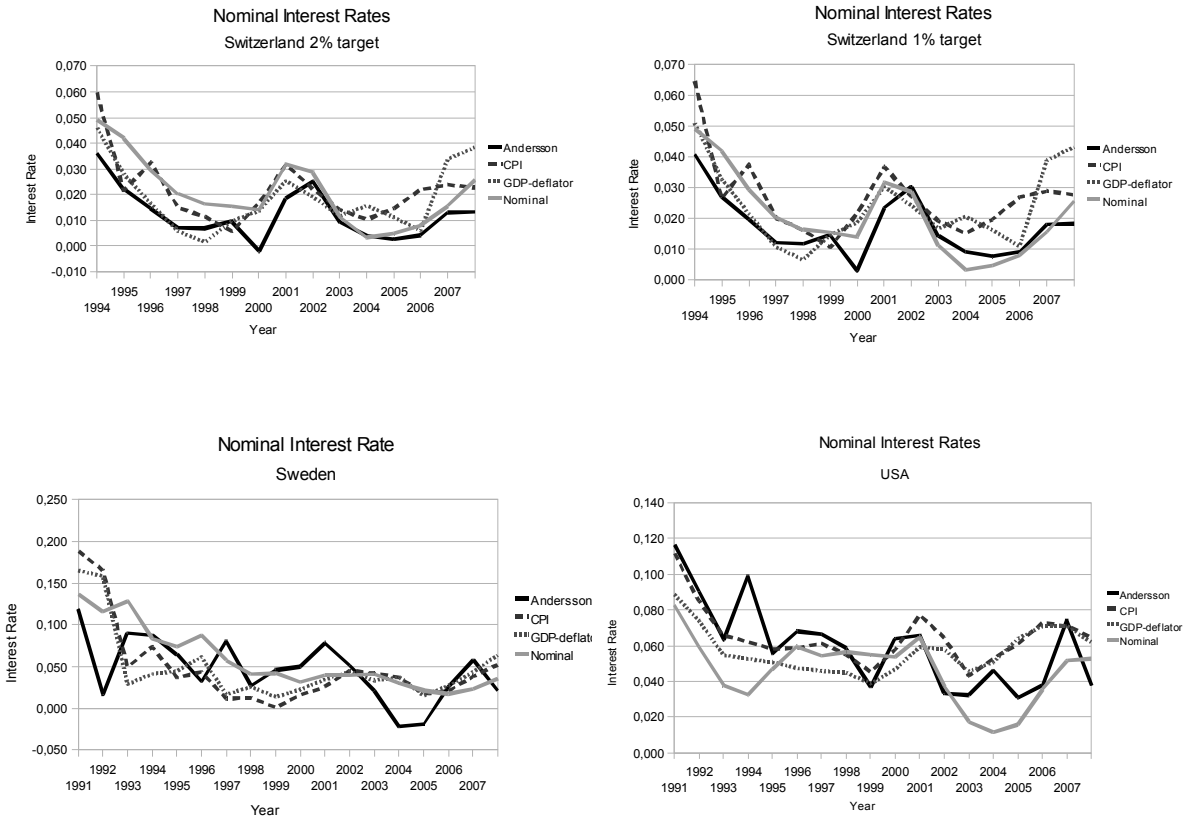
the dot-com bubble, but engaging in rate setting according to the Andersson index, which goes from 0 to 8 percent within a year, will likely not result in monetary stability. With that said, it should be noted that the outcome of all three Taylor indices argues that the central bank had a too high nominal interest rate during the last part of the 90's and a too low nominal interest rate in the wake of the dot-com burst. However, they differ quite substantially on how to conduct monetary policy after 2000-2002.

First off there's a methodological question that has to be dealt with regarding Japan. As you might recall from the method chapter the Taylor rule or the Taylor equation has a variable for inflation target. The problem in the case of Japan is that their central bank doesn't use an inflation target (Japanese Central Bank 1). Putting the variable to a value of 0 wouldn't be correct, since that would imply an inflation target of 0 percent, which is not true. The overall guideline for Japanese monetary policy is price stability, which necessarily is not the same thing as zero inflation. Considering the need for an inflation target in the equation I assigned it a value of 2%, since that on a global basis is a fairly common level for an inflation target.

As one might recall from the chart regarding Japanese inflation the different measures of inflation didn't differ in any extreme ways. Therefore, the interest rates in a Taylor framework doesn't differ that much from one another either. The interesting breaking point between the actual nominal interest rate and the Taylor rates is the crisis in the late 80's. That crisis was due to rapid and sustained price increases in asset prices, namely in real estate and the stock exchange with speculation following suit. However, the Japanese central bank did react to these price increases and speculations and has during the 00's been trying to stimulate the Japanese economy with next to zero interest rate.

The Norwegian central bank has an annual inflation target of 2.5% annually (Norwegian Central Bank 1). The GDP-deflator in this case is quite extraordinary compared to the other indices, but with that said it's also worth noticing that it's more or less the only index that predicts the dot-com bubble and, to some extent, the present financial crisis. However, as one might recall from chart 4.5 the GDP-deflator was showing a very high value for the rate of inflation and therefore it comes as no surprise that the Taylor rule indicates a high nominal interest rate. The question is if the Norwegian economy was as overheated as the GDP-deflator shows and if an initial raise of the nominal interest rate according to the GDP-deflator's results would've eased the economy in such a way that a second raise hadn't been necessary. Finally, it's also worth noticing that the Andersson index in this matter argues for a lower nominal interest rate than all the other indices. Both before the dot-com bubble as well as the present financial crisis.

*Chart 4.10 Comparison of Interest Rates – Sweden, Switzerland and USA*




A noted earlier the Swedish central bank holds an inflation rate range between one and three percent, thus setting the inflation target in the Taylor framework to 2%. The Andersson index argues for a higher interest rate before and during the dot-com bubble, but also argues for a lower rate during the recovering years. When working in a Taylor framework like this it's important to try to analyze the trends rather than the actual values. If for example the Swedish central bank in 2001 would've set the nominal interest rate to roughly 8% (as according to the Andersson index) the situation in the following years probably would've been different, since the inflation most likely would've been lower and it would also have been possible that the economy wouldn't have overheated in the same way as it did. What I'm mainly looking for in these comparisons are signals, that is, can an inflation index containing asset prices signal an overheating of the economy? In this case it actually does. Throughout the late 90's it sends signals of a higher interest rate and it also signals a rising inflation pressure in 2006 and 2007.

The Swiss central bank works a bit differently than for example the Scandinavian ones. Where other central banks have a target or a range where they like to keep their inflation the Swiss central bank has not so much a target as a limit that the inflation rate must not exceed. In the Swiss case this limit is 2% (Swiss Central Bank 1). This gives me some problems when setting the inflation target in the Taylor rule. In the left diagram in the above chart the target is

set to 2%, but when looking at Swiss statistics the inflation rate has more or less always been lower. If 2% would've been the target some fluctuation around two percent would've been a reasonable result. This is, however, not the case. This also shows in the chart where the Andersson index more or less consistently indicates a lower nominal interest rate than the other indices.

When changing the inflation target to 1% the result differs a bit. The relationship between the inflation indices is of course the same, but they now signal other nominal interest rates compared to the one that was actually set by the Swiss central bank. In this case it comes down to what, if any, inflation target the Swiss CB was working towards. This I don't know, but on a general level the indices correlate fairly well with the actual nominal interest rate, provided that the Swiss CB wanted the inflation around 1-2%.

In the American case it seems that their present problems aren't as much due to measuring difficulties as to mistakes made by their central bank. Even though all measures of inflation indicated a rising inflation rate in the years after the 9/11 attacks the Federal Reserves continued to keep what must be seen as an artificially low nominal interest rate. So instead of easing the economy the Federal Reserves spurred it. With that said it must be noted that the Andersson index isn't signalling a higher nominal interest rate than the "ordinary" inflation measures. That means that the problem according to my research wasn't due to that the Federal Reserves ignored price rises in the asset market, but rather ignored price rises as a whole. And the fact that the crisis resulted in asset crashes might as well be due to different policy decisions (Fanny Mae, Freddie Mac, bad regulation of financial markets, etc.) or other for us unknown reasons as for example bad inflation measurements and improper rent setting. In the Federal Reserves' defence the indices in chart 4.10 are based on an inflation target of 1.85%. The Fed just recently set a long-term inflation target range between 1.7-2.0%, and I used the average of the two as my target in chart 4.10 (US 1). Therefore, their actions are being compared as if they would've had an inflation target, which they didn't. This could mean that the Federal Reserves was well aware of the rising inflation, but chose not to change their rent-setting due to whatever reasons, political or not. In either way, the American part of the chart above gives good support for both the Taylor rule as well as inflation targeting, since the present-day crisis might have been eased substantially if proper monetary decisions would've been made in time.

# 5. Discussion

This chapter will consist of some brief concluding remarks regarding my results, followed by a discussion of them, and some thoughts about future research. In the discussion I will give special attention to three cases. The first one is the detailed Swedish case and the second one the group-based Swedish case and the third is the US case. This is because I believe that the detailed Swedish case is the main focus of my analysis and the index I've worked most thoroughly with. The group-based Swedish case will be discussed as a reference point to the detailed index, giving me the opportunity the highlight the differences between the two levels of aggregation and what effects that can be observed because of this. The US case is interesting because of other factors, mainly it's due to the fact that most high-ranking economic research stem from the US, thus making US the main object for analysis within the field of economics and because the US case is usually the one that all other cases are measured against.

## 5.1 Conclusion & Discussion

First, one can state that there are no clear results in the matter of judging the analysis. The reasons for this, however, don't necessarily have to come from an improper theoretical framework or a badly performed analysis. The main problem in the case of this thesis lies more within the data. Trying to measure all price movements within an economy is a massive task and I can't claim to have the whole economy covered to perfection with my data. Nonetheless I do believe I've been able to show some interesting results. My main point of analysis is the Swedish detailed case, which provides an analysis covering a large selection of separate price movements. Of course, the price data acquired through CPI-measures have gone through more work and preparation than for example my housing data. There is a long tradition of CPI-measuring and when calculating the CPI a lot of factors apart from just the price movement are taken into consideration, for example quality adjustments and technological development. It would've been even more preferable to have had the same

thorough work performed on my asset data, but irrespective of that some interesting points were observed. The Andersson index does take asset prices into consideration, but as for example in the case of the dot-com bubble the reaction seems to come too late, since the burst of the bubble happened in 2000 and the index signals its highest rate in 2001. The main reason for the quite small diversions from the other indices in this case is that the range of asset prices is much too small. The index consists of over one hundred consumer prices, but only a handful of asset prices, which, as I mentioned, are on a different level of aggregation. The inter-weighting, one could call it, is therefore probably too heavily biased towards consumer prices. It would thus be possible to find more interesting results if there were more asset price data and that data was more disaggregated or if the consumer prices also were dealt with on a group-based level of aggregation. The latter part I will discuss more thoroughly now, when discussing the Swedish group-based index.

The group-based Swedish index is in my opinion on one hand a better indication to whether or not asset prices play a part in the overall level of inflation, than the disaggregated, detailed index. This is, as I explained recently, mostly due to the level of aggregation between the different price types. Instead of breaking down clothing in different kinds of clothing, addressing each type with a weight, study their price movements and then construct an index with those kinds of clothing and their weights together with one price for all kinds of housing (apartments, houses, rented etc.), all kinds of clothing are now one group just as all kinds of housing is one group. This should lead to a more balanced index regarding the weights between the different categories, the inter-weighting.

So what does the Swedish group-based index say? The index actually takes into consideration and points out a rising inflation pressure in, for example, the late 90's, which stems from asset prices. In the group-based Swedish case the Andersson index in a Taylor-rule framework signals, in a different way than the CPI or the GDP-deflator, that the short-term nominal interest rate in the late 90's should be raised. This information originates from asset price data and thus wasn't taken into consideration by the Swedish central bank. I can't for sure state that if the central bank would've raised the interest rate or taken asset prices into deeper consideration the situation would've developed in any other way, since the world economy today is highly integrated and economic situations usually depend on more than just national rent setting. But I can say that what we have here is a model that based on conventional theories and methods within economics says that the inclusion of asset prices in the inflation measure argues for a different rent setting than a model based solely on consumer prices or the GDP-deflator in the running up towards the dot-com bubble in Sweden. It gives

the signals and a Swedish central bank acting according to it might just have altered the economic outcome and, maybe, prevented the stock market collapse.

When studying the years before the present economic recession one can see that the detailed Andersson index doesn't really signal a higher nominal interest rate than the other indices. Within a Taylor-rule framework all three inflation measures signal rising inflation and thus also rising interest rates. These rates, however, don't substantially differ from the actual interest rate that was set by the central bank. This is most likely due to the fact that the present crisis originates from the US. The Swedish economy wasn't mismanaged or severely overheated (though the stock market had seen a long period of substantial growth) and there were therefore no great need for big interest rate increases.

A common perception is that The US situation was in some ways different from, for example, the Swedish one. Asset bubbles in both the housing and the financial sector started to form, the public's debt increased and federal budget deficits grew. There are reasons to believe that both the asset bubbles as well as the debt increase were connected to the low interest rates set by the Federal Reserves, since a low interest rate usually encourages loaning and not saving. The present economic situation of course stems from a multitude of factors, but nonetheless it is my experience that most economists agree that the Fed's interest rate was too low, thus spurring unwanted behaviour in the economy.

So, would the US situation have been any different if the Federal Reserves were to account for asset prices in the inflation measurements? The Andersson index argues that so is the case, but so do the CPI-based index as well as the GDP-deflator-based index when put in a Taylor-rule framework. In the American case my analysis shows that all three indices signal a higher interest rate, so the (too) low rates in the US weren't due to a wrongly-calculated inflation measure, but rather poor decisions by the Federal Reserves. The US case can therefore neither prove nor falsify my hypothesis.

Besides having discussed the results regarding what I believe are my three most important objects of analysis I would like to further discuss my method and its implications from a critical perspective.

As I mentioned earlier there is a sort of bias within the data since the CPI-data is thoroughly tested and developed over the years, while the asset data is in a sense more "raw". What I mean by this is that there are quite a substantial number of economists and statisticians around the world working solely with CPI and CPI-data. This shows in the way the data is treated and calculated with, for example, quality adjustments and the low levels of disaggregation that are present within the CPI-data. The same does not hold true for most

asset price data, which is almost exclusively produced and dealt with on a more group-based level. The amount of CPI-data is also much wider than the amount of asset data, which also might make the inter-weighting lean too much towards the CPI-weights in my model.

Besides the above, there is also a methodological problem when comparing inflation across nations. Each nation, central bank or statistics institute has its own view and method of how to collect and calculate its data and indices. Though we might call it consumer price index in all nations, it's far from the same thing in Sweden, the US or Germany. That means that mere studies of inflation rates across countries might be deceiving, since two Swedish percent are not necessarily the equivalent of two American percent. If there's anything besides drawing attention to the role of asset prices that I would like to pass forward with this thesis, it is also the fact that what we believe to be a very standardised measure of inflation (CPI) isn't that standardised as one might think and therefore should be addressed with more care in cross-country studies.

What's written above about different ways of calculating inflation or CPI may not only be a problem on a national level, but on an international level as well. A misperceived rate of inflation, stemming from wrongly-calculated data, will lead the country in question to set a faulty interest rate, which could (and probably will) give the country some problems in the future. On an international scale this is no problem if the country in question is for example Sweden, which is to be seen as a fairly small player on the global economic scene. However, if the country in question is the US, the actions of their central bank will most likely get spill-over effects on other nations. Not only in the extreme cases as in the present sub-prime crisis, but also in more normal cases where small economies' interest rates in the long run can't deviate too much from larger economies' interest rates.

## 5.2 Future Research

Though I haven't been able to reach any finalised conclusions regarding the effect of asset prices within inflation measuring, I believe I've touched on a subject that demands more attention and research. After all inflation and subsequently monetary policy are highly important aspects of economics and could be seen as a foundation on which many other aspects of economics rest.

First of all it would be preferable to have more and more detailed data on different asset prices so they could be properly merged with the disaggregated consumer price indices. The

next crucial issue is the weighting. I've used a basic statistical method for weighting my indices. The real CPI is weighted on different principles such as the share of household expenses on a specific good or service. More statistical work of this kind is also needed to be able to create price indices including asset prices that would do themselves justice regarding both the level of detail as well as the overall quality of the data (details, technology adjustments, etc.). Completing these two main tasks would make it possible to create more accurate indices and thus for real testing the sustainability of the theoretical argument of Friedman, Alchian and Klein, Goodhart and others. The theoretical foundation that was presented in this thesis is strong, just as the notion that long-term inflation stems from money growth. These theoretical insights combined with new connected challenges as the Dubai credit crunch, rapid money growth in the US and what appears to be a soon-to-burst housing bubble in China together with overall stabile or low consumer price inflation gives credibility to further investigation of the role of the asset prices in monetary policy and the economy at large.

# 6. References

## 6.1 Books & Articles


Alchian, Armen A., Klein, Benjamin, 1973. "On a Correct Measure of Inflation", *Journal of Money, Credit and Banking,* Vol. 5, No. 1, pp. 173-191.

Bernholz, Peter, 2003. *Monetary Regimes and Inflation: History, Economic and Political Relationships*. Cheltenham: Edward Elgar Publishing Limited.

Bryan, Michael F, Cecchetti, Stephen G, O'Sullivan, Roisin, 2001. "Asset Prices in the Measurement of Inflation", *De Economist*, vol. 149, No. 4, pp. 405-431.

Clarida, Richard, Gali, Jordan, Gertler, Mark, 1998. "Monetary Policy Rules and Macroecnomic Stability: Theory and Some Evidence", *Quarterly Journal of Economics*, vol 115, pp. 147-180.

Diewert, Irwin W., 1995. "On the stochastic Approach to Index Numbers", *University of British Columbia Department of Economics Discussion Paper 95/31*.

Filardo, Andrew J., 1999. "Monetary Policy and Asset Prices", *Federal Reserve Bank of Kansas City – Economic Review*, Third Quarter 2000.

Fisher, Irving, 1911. *The Purchasing Power of Money: Its Determination and Relation to Credit Interest and Crises*. New York: Cosimo, Inc.

Fisher, Irving, 1918. *Elementary Principles of Economics*. New York: Cosimo, Inc.

Fregert, Klas, 2007. *Inflation*. Avesta: SNS Förlag.

Friedman, Milton, 1956. *Studies in the Quantity Theory of Money*. Chicago: the University of Chicago Press.

Friedman, Milton, 1973. *Money and Economic Development – The Horowitz Lectures of 1972*. New York: Praeger Publishers, Inc.

Friedman, Milton & Goodhart, Charles A. E., 2003. *Money, Inflation and the Constitutional Position of the Central Bank*. London: The Institute of Economic Affairs.

Friedman, Milton, Schwartz, Anna J., 1982. *Monetary Trends in the United States and the United Kingdom – Their Relation to Income, Prices and Interest Rates, 1867-1975*. Chicago & London: The University of Chicago Press.

Goodhart, Charles A.E., 2001. “What Weight Should Be Given to Asset Prices in the Measurement of Inflation?”, *The Economic Journal*, vol. 111, pp. 335-356.

Goodhart, Charles A.E., Hoffman, Boris, 2002. “Asset Prices and the Conduct of Monetary Policy”, *Royal Economic Society Annual Conference 2002*, No. 88.

Hume, David, 1752. *Of Money*. London: Routledge and Sons.

Shibuya, Hiroshi, 1992. “Dynamic Equilibrium Price Index: Asset Price and Inflation”, *Bank of Japan Monetary and Economic Studies*, vol. 10, No. 1, pp. 95-109.

Statistics Sweden, 2001. *The Swedish Consumer Price Index – A handbook of methods*. Örebro: SCB-Tryck.

Sørensen, Peter, Birch, Whitta-Jacobsen, Hans, Jørgen, 2005. *Introducing Advanced Macroeconomics: Growth and Business Cycles*. New York: McGraw-Hill Education.

Taylor, John B., 1993. “Discretion Versus Policy Rule in Practise”, *Carnegie-Rochester Conference Series on Public Policy*, vol. 39, pp. 195-214.

Wynne, Mark A., 1999. “Core Inflation: A Review of Some Conceptual Issues”, *ECB Working Paper Series – Working Paper No. 5*.

## 6.2 Internet References

About.com 1:
http://economics.about.com/cs/interestrates/a/real_interest.htm
Australian Central Bank 1:
http://www.rba.gov.au/MonetaryPolicy/about_monetary_policy.html
Japanese Central Bank 1:
http://www.boj.or.jp/en/type/exp/seisaku/expseisaku.htm
Nationalencyclopedin 1:
http://www.ne.se.ludwig.lub.lu.se/lang/inflation
New York Times 1:
http://www.nytimes.com/2008/01/20/magazine/20Ben-Bernanke-t.html?pagewanted=1&_r=1
Norwegian Central Bank 1:
http://www.norges-bank.no/templates/section____11330.aspx
SCB 1:
http://www.scb.se/Grupp/Klassrummet/_Dokument/kpienkelt.pdf
Swedish Central Bank 1:

http://www.riksbank.com/templates/Page.aspx?id=31634

Swiss Central Bank 1:

http://www.snb.ch/en/iabout/monpol/id/monpol_strat/6

US 1:

http://www.usinflationcalculator.com/interest-rates/long-term-inflation-target-of-17-to-2-set-by-fed/1000388/

# 7. Appendix – CPI Group Weights

*Table 7.1 Sweden actual CPI weights, 2000*

| Variable | Weight |
|---|---|
| Food & Beverages | 0.13 |
| Alcohol & Tobacco | 0.04 |
| Cloth. & Footwear | 0.06 |
| Shelter/Housing (cost of living, not actual house price) | 0.32 |
| Furnishing & Hshld equipments | 0.05 |
| Health care | 0.03 |
| Transports | 0.13 |
| Communication | 0.03 |
| Recreation & Culture | 0.11 |
| Restaurant & Hotels | 0.05 |
| Misc. Goods & Services | 0.05 |

Source: (SCB 1)

*Table 7.2, Australia 1982-2007 / 1973-2007*

| Variable | Weight 1982-2007 | Weight 1973-2007 | Difference |
|---|---|---|---|
| Alcoholic Beverages | 0.0250 | 0.0443 | -0.0193 |
| Clothing & Footwear | 0.1159 | 0.1157 | 0.0002 |
| Communication | 0.2772 | 0.1877 | 0.0895 |
| Education | 0.0069 | - | - |
| Food & Beverages | 0.0299 | 0.0526 | -0.0227 |
| Postal Charges | 0.0653 | - | - |
| Transport | 0.0360 | 0.0555 | -0.0195 |
| Motor Vehicles | 0.0807 | 0.0992 | -0.0185 |
| Tobacco | 0.0019 | 0.0056 | -0.0037 |

| | | | |
|---|---|---|---|
| Restaurant Meals | 0.0248 | - | - |
| Electricity | 0.0428 | - | - |
| Goods | 0.0398 | 0.0621 | -0.0223 |
| Household Equipments & Operations | 0.0899 | 0.0940 | -0.0041 |
| Health Services | 0.0101 | 0.0229 | -0.0128 |
| Shares | 0.0422 | 0.1169 | -0.0747 |
| House Prices | 0.0001 | 0.0002 | -0.0001 |
| Producer Price Index | 0.1115 | 0.1432 | -0.0317 |

*Table 7.3, Japan 1970-2007, Norway 1980-2007*

| **Japan** | | **Norway** | |
|---|---|---|---|
| **Variable** | **Weight** | **Variable** | **Weight** |
| Alcohol & Tobacco | 0.0688 | Alcohol & Tobacco | 0.0368 |
| Clothing & Footwear | 0.0536 | Clothing & Footwear | 0.1404 |
| Communication | 0.0572 | Communications | 0.0328 |
| Education | 0.0327 | Food & Beverages | 0.0927 |
| Electricity, Gas, Water | 0.0633 | Furnishing & Household Equipments | 0.1382 |
| Food & Beverages | 0.0766 | Health | 0.0430 |
| Housing | 0.0489 | Hotel & Restaurants | 0.0508 |
| Furnishing | 0.0965 | Electricity, Fuel, Water | 0.0465 |
| Medical Care (Health) | 0.0753 | Misc. Goods & Services | 0.0552 |
| Recreation & Reading | 0.0581 | Recreation & Culture | 0.0925 |
| Services | 0.0471 | Rent | 0.0551 |
| Goods | 0.0728 | Transport | 0.0565 |
| Transport | 0.0682 | Share Prices | 0.0261 |
| Restaurants | 0.0540 | Wages | 0.0018 |
| Shares | 0.0116 | House Prices | 0.0004 |
| Wages | 0.0005 | Producer Prices | 0.1314 |
| House Prices | 0.0017 | | |
| Producer Prices | 0.1131 | | |

*Table 7.4, Sweden 1980-2007, Switzerland 1983-2007*

| **Sweden** | | **Switzerland** | |
|---|---|---|---|
| **Variable** | **Weight** | **Variable** | **Weight** |
| Food & Beverages | 0.0609 | Alcohol & Tobacco | 0.0314 |
| Alcohol & Tobacco | 0.0125 | Clothing & Footwear | 0.0609 |
| Clothing & Footwear | 0.3068 | Communication | 0.0062 |
| Shelter/Housing | 0.0152 | Education | 0.0127 |
| Furnishing & Household Equipments | 0.0625 | Food & Beverages | 0.0665 |
| Health Care | 0.0019 | Maintenance & Household Equipments | 0.0638 |
| Transport | 0.0137 | Housing & Energy | 0.0196 |
| Communication | 0.0427 | Recreation & Culture | 0.0496 |
| Recreation & Culture | 0.1115 | Transport | 0.0277 |
| Restaurants & Hotels | 0.0110 | Hotels & Restaurants | 0.0147 |
| Misc. Goods & Services | 0.0226 | Misc. Services | 0.0185 |
| Wages | 0.0078 | Misc. Goods | 0.0868 |
| Share Prices | 0.0583 | Share Prices | 0.0027 |
| House Prices | 0.0023 | Wages | 0.2008 |
| Producer Prices | 0.2704 | House Prices | 0.0033 |
| | | Producer Prices | 0.3347 |

*Table 7.5, United States 1980-2007*

| Variable | Weight |
|---|---|
| Alcohol & Tobacco | 0.0035 |
| Clothing & Footwear | 0.2117 |
| Energy | 0.0314 |
| Food & Beverages | 0.0266 |
| Furnishing & Household Operations | 0.2059 |
| Medical Care | 0.0045 |
| New Vehicles | 0.0998 |
| Misc. Services | 0.0130 |
| Shelter | 0.0142 |
| Transportation | 0.0405 |
| Tuition Fees – School/Child Care | 0.0020 |
| Postage | 0.0234 |
| Misc. Goods | 0.0860 |
| Tuition Fees – College | 0.0017 |
| Rent of Primary Residence | 0.0165 |
| Restaurants | 0.0257 |
| Hotels & Motels | 0.0066 |
| Share Prices | 0.0038 |
| Wages | 0.0004 |
| House Prices | 0.0005 |
| Producer Prices | 0.1823 |